Interfaces Negation-Syntax-Brain

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Preliminaries



Illustration:

1 Preliminaries

1.1 Introduction

The main focus of this dissertation is on negation. More specifically, it is about the licensing of sentential negation. In Danish, as in many other languages, negation can be realized as a negative adverbial, such as *ikke* 'not' or *aldrig* 'never', or as a negative indefinite quantified object, such as *ingen biler* 'no cars' or *ingenting* 'nothing'. This is the difference between, e.g. *no* and *not any*. In the Scandinavian languages (as well as in many other languages from different language families), both types of negative marker must be in the middle of the clause in order to license sentential negation, as in *jeg har <u>ikke</u> fået nogen penge*, 'I have not received any money' and *jeg har <u>ingen</u> penge fået*, literally 'I have no money received'. As this is not the canonical position for objects, I shall argue that in such constructions, negative indefinite objects undergo syntactic displacement, or *movement*, to the position of negation. I refer to this movement as *NEG-shift*, a sub-case of *operator movement* which is distinct from other types of movement of negative elements.

The aim of the study is two-fold, which is reflected in the two parts of the dissertation. Part one is a linguistic study – a case study in *theoretical and comparative linguistics*. The argumentation for the linguistic analyses involves a wide range of languages, including the Scandinavian languages, English, Hebrew, Portuguese, Finnish, Polish, German, and Dutch. The goal is to provide an analysis based on universal principles that will account for (the variations in) the movement phenomena and the constraints they are subject to. I shall argue that these constraints include syntactic constraints on computation (structure-dependency) and economy, as well as constraints on information structure. At the heart of this approach is the notion of derivational *phases* and *interfaces*. Syntactic computation interfaces with other cognitive systems; in this way constraints on information structure may motivate syntactic movement, including NEG-shift.

Part two is a *neurolinguistic* study. Based on findings in linguistic impairment after focal brain damage in a wide variety of languages, it has been argued that syntactic processing is localized in the brain in a single area in the left hemisphere. I present the results of a neuroimaging study on operator movement (NEG-shift and *wh*-movement), and hypothesize that syntactic processing is implemented in a distributed cortical network involving both hemispheres. This hypothesis is backed up by other neuroimaging studies on movement in other languages. The hypothesis is formulated within the linguistic framework of the minimalist program and it is based on the syntactic analysis of NEG-shift. Again, *interfaces*

are at the heart the approach I adopt, and I shall argue that the interfacing between syntax and other cognitive systems also has a neural reflex.

In the preliminaries, chapter 1, I first outline the *minimalist* approach to language and go through the operations involved in the derivation of the clause and discuss derivational *economy* and *Structure-dependency* in section 1.2. I briefly present the articulated structure of the clause that I shall argue for in my analysis and discuss how this relates to derivational phases. I furthermore briefly introduce the framework of *Optimality Theory* which I shall adopt to account for constraint interaction at the interface between syntax and information structure. I then discuss the *systemic discontinuity* between the two approaches and how they can nevertheless combined; this discontinuity, I argue, is parallel to *phase-transitions* in physics, e.g. in the boiling and freezing of water. Next, in section 1.3, I argue that negation is a universal category that is reflected in the syntactic structure. I present tests for sentential, constituent, and meta-negation. In section 1.4, I argue that syntactic movement should be treated as uncontroversial and that it is in fact also part of a range of non-generative and/or functional approaches to language. Furthermore, abstract computation and abstract constituents, which are required for syntactic movement, are ubiquitous in the natural sciences as well.

The focus of part one, which consists of chapters 2 and 3, is on sentential negation. Chapter 2 is about negation and quantifiers. In section 2.2, I first present data from a comparison of three Danish corpora of Danish showing that NEG-shift is widely used interchangeably with the semantically equivalent not any construction. I present arguments that Danish ingen 'no' need not be a post-syntactic merger of ikke nogen 'not any'. In section 2.3, I compare NEG-shift and quantifier raising (QR) and argue that NEG-shift is not a subcase of QR and that they target different syntactic positions; furthermore, negative quantifiers in situ have zero-quantification readings. I argue that the cross-linguistic variation in NEGshift and QR are captured with a phase-based approach to syntax that also allows for covert operator movement. I also propose that negative adverbials with sentential scope are merged lower in the structure and undergo movement to license sentential negation. In section 2.4, I first present the cross-linguistic data on NEG-shift and the effects of intervening verbs and prepositions (where Holmberg's Generalization is respected to varying degrees) and then I propose an Optimality Theory analysis to account for the variation. In section 2.5, I introduce further complications and consider the effects of structure preservation, object shift, and NEG-shift on double objects.

Chapter 3 is about the negative adverbial operator, *ikke*. First, in section 3.2, I argue that English *not* and Danish *ikke* should be analyzed as phrases rather than heads,

despite the fact that they cannot be topicalized. I propose a constraint on the feature composition of topics and argue that it can account for the cross-linguistic variation, both *synchronically* and *diachronically*. I then present an Optimality-theoretic analysis of the historical developments in Danish and English. Next, in section 3.3, I consider negation and infinitives, more specifically, the so-called *split infinitive*. I argue that the infinitive marker is merged as the head of the topmost functional projection in the VP-domain. Syntactic variation is then accounted for by assuming that the infinitive marker undergoes parameterized stepwise *head movement* across the adjunction sites for adverbials and the specifier housing sentential negation. I argue that this movement is *feature-driven*.

Part two, is about syntactic movement and the brain. In section 4, I first outline the biolinguistic approach followed by a discussion of two fundamental challenges for neurolinguistics. Next, discuss the notion of modularity and the problem of implementation which leads naturally to the discussion on lateralization and localization and, in turn, to the discussion on the role of Broca's area. I argue that the interfacing between syntax and other cognitive systems is reflected in the brain as a distributed network of computational centres. I propose the Domain Hypothesis stating that the activation patterns in the network reflect different syntactic domains.

Section 5 is about syntax in the brain. I first discuss some methodological issues in neuroscience, such as neuroimaging techniques, random- vs. fixed-effects analyses, and corrected vs. uncorrected results. Next, I present the design of and result from an fMRI study on Danish operator movement and argue that the results are compatible with the Domain Hypothesis. Also, I review four fMRI studies from the literature and argue that they are also compatible with the hypothesis. Finally, I briefly consider working memory approaches to movement, before turning to a range of empirical predictions the hypothesis makes for further research.

Finally, in chapter 6, I conclude that movement takes place in the computational system and is therefore subject to syntactic constraints on Structure-dependency and economy; from a *systemic* point of view, movement is motivated by feature checking. However, from a *functional* point of view, by means of interfacing between syntax and other cognitive systems, movement may also be motivated by, e.g., constraints on information structure (as in topicalization, NEG-shift, and QR) or by prosody (as in object shift). The Domain Hypothesis is a theory about the implementation of this interfacing in the brain, and there appears to be a correlation between the syntactic notion of a strong phase and the cortical fingerprints of syntactic movement.

In the next section, I begin by giving an introduction to the minimalist program.

1.2 Linguistic Theory

1.2.1 The Minimalist Framework

The goal of generative linguistics is to account for the human linguistic competence. As language is a universal and species-specific human trait, this competence is conceived as a universal grammar (UG) rooted in the human genetic endowment. UG consists of a set of basic *universal principles* that are shared by all languages of the world. Furthermore, there is a set of *parameters* whose settings determine the variable properties of any language of the world. Together, the principles and parameters account both for similarities and for variations / differences (the approach is also called Principles & Parameters, or P&P, named after these two components). This is motivated by the fact that languages are different in various but limited and non-arbitrary ways. That is, during diachronic change, first language acquisition (L1), and possibly also second language (L2) learning; language can only 'unfold' within a certain constrained space. The number of possible states the language faculty can attain is large but finite.

Language acquisition is viewed as the setting of these parameters on UG by exposure to the ambient language. From this it follows that the goal of generative linguistics is not only to describe the details of one or more specific languages but rather to formulate what determines the grammar of *any* language: "We then seek to discover theories that meet the conditions of descriptive and explanatory adequacy – that are true, respectively, of L (particular grammars) and of S₀ (universal grammar, UG)" (Chomsky 2004: 104). By necessity, such an approach is *comparative* (typological) in nature (see e.g. Haegeman & Guéron 1999: 581-649).

Much of the work in generative linguistics in the Government & Binding framework in the 1980s involved the postulation of ever more complex principles. The *minimalist program* (MP, Chomsky 1995, 2001) is a move away from excessive complexity. As summed up by Radford (1997: 515), MP is a "theory of grammar [...] whose core assumption is that grammars should be described in terms of the minimal set of theoretical and descriptive apparatus necessary."

At the heart of linguistic competence is the syntactic core, the computational system of human language (C_{HL}) which derives a set of representations, Phonetic Form (PF, sound) and Logical Form (LF, meaning) (cf. 'signifier' and 'signified' in the Saussurean sign) from a lexical array or numeration. This derivation proceeds in a manner specified by *computational principles* and *economy* (cf. section 1.2.3 below). PF and LF are then sent to the performance systems, the Articulatory-Perceptual systems (AP) and the Conceptual-Intentional systems (CI), respectively. The derivation from numeration to LF is known as *narrow syntax* and

consists of recursive and cyclic Merge and Move. (I return to this in chapter 2, section 2.3, and chapter 3, section 3.3.) The LF representation is assumed to be universal (common to all languages), while PF is subject to considerable cross-linguistic variation.





The lexicon contains lexical items that are specified for semantic (their meaning), phonological (sound), and formal features (Chomsky 2001: 10). The phonological features are interpreted at PF, while the semantic features are interpreted at LF. That is, phonological and semantic features are **interpretable**; they are instructions to the performance systems (AP and CI) about interpretation. The formal features are features that drive the derivation but they are **uninterpretable** themselves; they cannot be given an interpretation at the interfaces, and must be eliminated during the derivation before reaching LF or PF. This requirement is an interface condition called the principle of *Full Interpretation* according to which "there can be no superfluous symbols in representations" (Chomsky 1995: 27). Uninterpretable features include selectional features (requirements on the categories of complements), EPP (specifier requirement), and **unvalued** φ -features (person, number, and gender).

1.2.2 Syntactic Derivation

The structure-building computation, the derivation, consists of a small set of basic operations: **Select**, **Merge**, **Agree**, **Move**, and **Transfer**. As a simple illustration of these operations, I shall go through the derivation of the *yes/no*-question:

(2) *Will he slowly eat the steak?*

I shall adopt a system to represent syntactic structure called the X-bar system. It is a conventional labelling system; the labels themselves have no interpretation outside conventional category status. Chomsky (1995: 241-249) abandons the X-bar system in favour of a *bare phrase-structure* which satisfies the *Inclusiveness Condition* as there are no barlevels and no difference between lexical elements and heads projected from them: "in other words, that the interface levels consist of nothing more than rearrangements of lexical features" (Chomsky 1995: 225); "no new objects are added in the course of computation (in particular, no indices, bar levels in the X-bar theory, etc. [...])" (Chomsky 1995: 228; see also Chomsky 2001: 2).

However, the *structural relations* of the X-bar system still hold, and the X-bar system is still widely used in the literature because labels are convenient, common, and reasonably well-understood. Furthermore, it represents the uniformity of structural relations and order of projections in a transparent way. For these reasons, I shall adopt the X-bar system throughout.

The minimal projection of a category X is X°, the head, which is the element that gives the whole projection XP, the maximal projection, its characteristics. (In Chapter 2, sections 2.3.6-2.3.9, I shall argue that certain heads can have more than one specifier.) I shall describe adjuncts, specifiers, and complements as I go along.

(3) X-bar structure



At first, operative complexity is reduced by making a once and for all selection of a lexical array LA, the set of lexical items needed for the derivation (or in case one or more items are needed more than once, a numeration) from the lexicon: **Select** LA={ $\alpha, \beta, \gamma, ...$ }. In the present example, we have Select LA={*will, he, eat, slowly, the, steak,* OP, C^o, T^o, v^{o} }. Note that besides the lexical elements that are actual words, there is also a set of functional categories; C carries the illocutionary force of declarative, T is marked for past tense, and v is the licenser of an agentive argument (which will be the subject of the clause here); OP is a

phonologically empty (i.e. silent or *covert*) question operator (see e.g. Radford 1997: 294, Adger 2003: 354).

Of the structure-building operations, **Merge** ("concatenation", "unification", basegeneration, insertion) is the most elementary: it is a **binary** operation that (by Select) takes two constituents from LA, say, { α , β }, and combines them into a new syntactic constituent. The label of this new constituent depends on which one of the two merged elements 'projects'. Thus, Merge is **asymmetric** as only one of them can project. In the present example, cf. (2) above, first the determiner *the*, which is a head D°, is merged with the noun *steak*, which is the head of and only constituent in its own noun phrase NP, to form a DP. The constituent is a DP because *the*, D°, selects a complement: the lexical entry for *the* specifies that it takes a noun phrase complement. *The* has an **uninterpretable** selectional [N] feature which is deleted upon merger with the NP complement. The result is illustrated in (4)a below. From here on, I leave out selectional features in the structural representations.

Next, *eat* is merged with *the steak*. *Eat* is a verb whose lexical entry specifies that it is transitive and takes a DP object. (The selectional feature is deleted on merge.) Again the merger results in a constituent that gets its label from the selecting head such that V^o projects a VP, see (4)b.



When an element is inserted (merged) into the structure, it is removed from the LA, such that after (4)b is formed, we have LA={*will, he, slowly, eat, the, steak, OP, C^o, T^o, v^o}*.

Then a 'light' abstract causal verb v° ('little v') is merged with VP (v° selects VP) to form v' (a non-maximal projection of v°). This light element has no phonological features – it is a so-called zero-morpheme (but it has semantic features: it means 'cause'). It is also a bound morpheme, that is, it is affixal in nature, and it attracts the verb which adjoins to it. This brings us to the operation **Move** ("dislocation", "displacement", Internal Merge, Remerge, Copy).¹ Thus the verb moves to v° leaving behind a phonologically silent copy or trace of itself in V^{\circ} (I leave aside the internal structure of the DP object):



This is an instance of **head** or **X^o-movement**, that is, from one X^o-position to another. Throughout I shall disregard the internal structure of derived syntactic heads (unless it is crucial to the argumentation) and represent (5) as in (6). After v^o is merged it is deleted from the LA:



But v° not only selects a verbal complement, it is also requires an agentive argument, the Agent (here, the eater) as a specifier (recall that v° is a causal verb; the 'causer' is the Agent). Thus, merging *he*, which is the head of and only element in a DP, and *v*' forms *v*P as the selector is *v*'. Or rather, v° is equipped with a feature that allows it to have a specifier, a so-called EPP-feature (I return to this below). Merging an element with *v*' 'checks' the EPP-feature on v° .

¹ I shall express no preference here as to whether displacement is movement that leaves traces in base-positions (copy and deletion) or copying where only the topmost copy gets a phonological interpretation (copy and head-of-chain spell-out). I use the traditional term movement and leave this debate for further research. Nothing in what I have to say depends on one or the other option.



Next the manner adverb *slowly* (head and sole element in an adverbial phrase AdvP) is merged with vP as the meaning of *slowly* applies to the meaning of vP; in other words, *slowly* has **scope** over vP. This time, Merge is not motivated by selection (neither *slowly* or vP selects the other, neither as complement nor as specifier – adjuncts are defined as being optional), and therefore there is no projection of structure: the category is left intact. This operation is **adjunction**: *slowly* is adjoined to vP which means that the resulting category is another vP:



For reasons of space, I have left out the category and structure of *he*, the specifier of *v*P. Throughout I shall leave out such details about specifiers in general unless they are relevant for the argumentation, and the same goes for phrases that contain only a single element, such as the AdvP, *slowly*, though I do specify the category itself.

So far, the derivation contains the **thematic** information, what we might informally call the "who did what to whom": the predicate is *eat*, *he* is the agent, the eater, and *the steak* is the theme, the eaten. The v° head, the topmost head in the structure so far, is a **functional** head (it is not a lexical element) associated with a full argument structure. This *v*P is modified by the adverb *slowly* specifying the manner of the eating of the steak. Next, the argument structure is anchored in time; this is done by merging the T^o head, which is specified for present [-Past] tense, with *v*P. As T^o (*will*) selects *v*P, T^o projects and as T^o requires a specifier (it has an EPP-feature), the resulting structure is T', not the maximal projection TP:



The auxiliary verb *will* is inherently tensed (it has no non-finite form) and is therefore merged into the structure together with T^o (they are merged together before they are merged with vP). T^o is a functional head that adds a temporal dimension to the thematic information in vP. Furthermore, as it is realized as the modal verb *will*, it also adds modality to the meaning.

T^o (*will*) has **unvalued** φ -features, a shorthand for [Person], [Number], and [Gender] features. Even though person, number, and gender inflection is not always visible, it is assumed to be there as abstract inflection or zero-morphology. Thus, in the present example, (2), T^o also has [*u*Gender], [*u*Person] and [*u*Number], though English morphology is rather deficient and *will* has the same form in all persons. With other verbs, 3rd person singular is inflected, but only in the present tense, namely, the –*s* ending, on for example, *she speaks* vs. *they speak* (present) and *she/they spoke* (past). In many other languages than English, there is more inflection. For example, in Icelandic, there is different inflectional endings for each person and number in all tenses, while Hebrew also has gender marking but only has φ -inflection in the past and future tense; in German, verbs do not inflect for gender but have person and number inflection in all tenses.

Unvalued features are uninterpretable and must be assigned a value. The unvalued φ -features make T^o a **probe** that searches down through the structure for a matching **goal**: a constituent with a valued set of φ -feature. There are two potential matching goals that are specified for φ -features, namely, the subject *he* in spec-*v*P and the complement of V^o, the object *the steak*. The derivation is constrained by principles of computational economy, one of which is the *Minimal Link Condition*, requiring that operations yielding long-distance dependencies be local. Thus, the probe finds the closest matching goal, *he* in spec-*v*P, and the two enter into **agreement**.



The process **Agree** valuates the unvalued features on the probe by matching it to the goal; as φ -inflection has no semantic interpretation, the now valued φ -features on T^o are "deleted from the narrow syntax but left available for the phonology (as they have phonetic effects)" (Chomsky 2001: 5).

As mentioned, T^o also requires an element as its specifier; it has an EPP-feature which forces it to project a specifier. From a different perspective, the clause must have a subject which is why an element must occupy the specifier of TP, abbreviated spec-TP. This requirement is also know as the *Extended Projection Principle* (Chomsky 1981, Grimshaw 1991), which in abbreviated form gives name to the EPP-feature, the *subject-predicate relation* or *nexus*. Simplifying somewhat, as there are no more lexical items that could be potential candidates for a specifier in the lexical array, it must be found among the elements that have already been merged into the structure (additional factors may also play a role, such as θ -roles, expletives and quasi-arguments). The EPP-feature is an **uninterpretable** feature that must be checked and deleted in the course of derivation. This is done by attracting the goal matched by agreement, namely, *he*: As illustrated in (11) below, the operation **Move** remerges *he* as the specifier of T^o and leaves a trace *t* (see footnote 1 on page 18 above) in its 'base-position' spec-vP.

This is an instance of **phrasal** or **XP-movement**. Note that XP-movement is crucially dependent on (motivated by) (i) the application of Agree on a probe and a matching goal, and (ii) the presence of an EPP-feature to license a specifier position as a target. Note that the EPP-feature is not an unvalued feature: it is not a feature that has any meaning with any given value (e.g. +/-EPP, 1/2/3EPP); it is simply uninterpretable and is deleted without valuation.



Next, C^o selects and is merged with TP (and C^o is deleted from LA). C^o carries interrogative force, i.e., it has an interrogative feature [+Q] that turns the sentence into a question (a [-Q] feature gives the sentence declarative force). This [+Q]-marked C^o is affixal and attracts the closest suitable X^o, namely T^o; the Minimal Link Condition blocks attraction of lower heads, such as v^o .



C^o also has an EPP-feature which is checked by merging the operator OP (which has a [+Wh] feature) as its specifier, as in (13) below.



Evidence for the EPP-feature on C^o can be seen by considering *wh*-questions such as the object question in (14) where the object *what* is moved to spec-CP to check EPP on C^o.

(14) What will he slowly eat?

The question then is what triggers the movement and why the subject which is closer to C^o is not moved instead of the object *what*. The answer is that C^o, apart from the [+Q] feature, has an unvalued (i.e. uninterpretable) [*u*Wh] feature which must be checked and deleted. The probing [*u*Wh] C^o finds the matching [+Wh] object *what* and Agree applies and valuates and deletes the feature on C^o. The EPP-feature then ensures that the object is moved to spec-CP.

At this point, the lexical array is exhausted – all elements have been merged into the structure and deleted from LA – and the derivation is complete. Because all uninterpretable features have been valuated and/or deleted, all the remaining elements in the structure can be assigned an interpretation at both LF and PF. When a structure satisfies the principle of *Full Interpretation* it is said to **converge**. Derivations that result in structures that fail to converge at one or both of the interfaces are said to **crash**. For example, if φ -features on, say, T^o are left unvalued, Full Interpretation will be violated at LF because φ -features cannot be assigned a semantic interpretation, and the derivation crashes – regardless of the fact that the derivation would converge at PF because φ -inflection can be assigned a phonological interpretation.

This leads to the last of the computational processes, namely, **Transfer**. When the derivation is complete, the syntactic representation is transferred to the interfaces for

interpretation, clearing the 'workspace': the elements in LA are all deleted and the structure built from it has undergone Transfer. Structures that have undergone Transfer are no longer accessible for further syntactic computation which is an important aspect of the phase-based approach in section 1.2.5 below.

1.2.3 Economy and Constraints on Computation

The structure building processes are subject to some general constraints on computation which basically fall in two categories: *Structure-dependency* and *Economy*.

To begin with, syntax is structure-dependent. The representation has hierarchical structure which (in the simplest case) is the inevitable result of successive Merge. Also the structure is binary: the syntactic tree has binary branching because at each node the branches split in two and never more than two. Again, this follows from the binary nature of Merge and Move. Movement operations are very clear examples of *Structure-dependency*. First of all, the elements that can undergo movement together are taken to form a constituent, whereas elements that can not move together possibly do not form a constituent. In other words, Move as well as Merge applies to constituents, not to non-constituents. For example, in (13) above, *slowly eat the steak* is a constituent, while *slowly eat or eat the* not. Only the former can be fronted (topicalized) in the declarative equivalent and result in a well-formed string (t₁ is the trace/silent copy of the moved constituent):

(15)	a.	[Slowly	eat the	steak] ₁	he	will	t_1			
	b.	*[slowly	$eat]_1$		he	will	t_1		the	steak
	с.	*[eat the	e] ₁		he	will	t_1	slowly		steak

A second example of structure-dependency is question formation. The *yes/no*-question corresponding to a declarative clause differs in having 'inversion'; the first finite auxiliary verb moves to C^o where it precedes the subject. However, not just the first verb in the numerical sense must move – it has the be the first and finite auxiliary verb in the main clause (t_v is the trace of the verb):

a. [[The stuff that should have been thrown away]
is still taking up space in the garage].
b. [Is [the stuff that should have been thrown away]
t_v still taking up space in the garage]?

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c. *[Should [the stuff that t_v have been thrown away] is still taking up space in the garage]?

A third aspect of structure-dependency is that syntactic movement is subject to *Structure Preservation* or *Conservation*. Movement may "alter structure only in ways that retain basic phrasal relations" (Saddy & Uriagereka 2004: 388, Chomsky 1995: 318-319; see also the licensing constraints in chapter 2, section 2.4.8.1). Movement from an XP position (i.e. specifier, complement, or adjunct) into a head position or vice versa (Improper Movement) is not allowed. Thus, even though the determiner is naturally a constituent (a minimal constituent), it cannot be fronted to spec-CP: a head cannot move into an XP position:

(17) [The]₁ He will slowly eat t_1 steak

Syntactic derivation is subject to the *Extension Condition* (Chomsky 1995: 190-191, 327-328; Adger 2003: 95, (158)), a fourth aspect of Structure-dependency, which states that Merge and Move can only target the 'root projection' of the tree. That is, elements can only be merged to the topmost node of the tree and movement can only target the topmost specifier. Merge and Move build upwards and extend the structure. This yields the successive cyclic structure building we saw in the previous section.

Besides the structure-dependency constraints on computation, syntax is also subject to constraints on computational *economy*. First of all, as mentioned in the previous section, syntactic computation is subject to the *Minimal Link Condition* MLC (Chomsky 1995: 311, (110); Adger 2003: 384-386), requiring that operations yielding long-distance dependencies and feature matching/checking in general be local – that is, between a probe and the closest c-commanded match (this is also known as *Locality, Relativized Minimality, Closest Attract, Shortest Move*). C-command is a structural relation between an element and all the elements contained in its sister in the tree, e.g., between the probe and its (c-command) domain. For example, in the tree in (18) below, YP is the sister of X° (they share the same mother, namely, X'). Thus, the domain of X° is everything c-commanded by X°, namely, YP and all that is contained in YP: WP, Y°, and ZP (and everything contained in each of these, such as spec-WP, W°, the complement of W°, and spec-ZP, Z° and the complement of Z°).



For example, the unvalued and therefore uninterpretable feature [uF] on X° probes for a match in its domain YP where there are two potential matches WP and KP, both with a valued matching feature, one [+F] and the other [-F]. However, under the MLC operations are local, and the closest match for X° is WP; Agree applies to (X°, WP) and [uF] is valuated by [+F] and deleted.

A second constraint is *Economy of Derivation*, which states that movement must be motivated, that is, triggered by feature checking (i.e. uninterpretable features on probes, or, for heads, by affixal heads). That is, movement only takes place as *Last Resort* (Chomsky 1995: 130). In other words, there can be no superfluous operations. This is what Saddy & Uriagereka (2004: 389) call *Symmetry Breaking*: movement is "allowed to apply only when its action results in a representational consequence".

Finally, the principle of *Full Interpretation* (Chomsky 1995: 27, 219-220; Adger 2003: 85) states that there can be no superfluous elements; representations must be minimal. As mentioned in the preceding section, all features and elements must be assigned an interpretation at, or be deleted before, the interface levels PF and LF. To be *convergent*, a derivation has to satisfy Full Interpretation at both LF and PF.

The principles of economy ensure that the derivation is not only *convergent* but also *optimal*.

1.2.4 The Structure of the Clause

In this section I shall discuss the structure at the level of the clause as it looks after a full derivation.

As I argued in section 1.2.2, the structure of the clause is *selected* in a top-down manner: V^o selects the object (and indirect object in so-called double object constructions), v^o selects VP (and the agent argument), T^o selects vP, and C^o selects TP. In this sense, selectional features derive the backbone of the clause, the *clausal spine*. Crucially, in VP, V^o selects the

'internal' arguments and assigns them thematic roles, or θ-roles. A typical example would be when the main verb selects one or two DP objects and assigns them θ-roles, as in *buy* [*my friend*]_{Beneficiary} [*a beer*]_{Theme}. Likewise, the causative light verb v° selects and assigns the θrole Agent to its DP specifier. Inside *v*P and VP there is thus a close relationship between selection and θ-role assignment; V^o selects a Theme as its complement and (if it is a ditransitive verb) a Beneficiary as it specifier, and v° selects an Agent as its specifier:



However, it is in no way clear that v° assigns a θ -role to VP and if so which role it would be. The same goes for the relationship between T^o and vP, and between C^o and TP. A possible solution is to assume that there is only selection when there is also θ -role assignment: "In order to keep the relation between little v and VP conceptually distinct from selection, we will just assume that there is a special **Hierarchy of Projections**" (Adger 2003: 135). That is, the hierarchical ordering of the projections in the clausal spine is fixed: [CP [TP [vP [VP]]]]. Structures that deviate from this order cannot be derived.

From a different perspective, the structure of the clause is *projected* in a bottom-up manner; VP is the thematic core, the *lexical* projection, on top of which *functional* XPs are projected. These projections, vP, TP, and CP in a sense extend the meaning of VP (not just the structure); they are *extended projections* of VP (Grimshaw 1991) (this is the semantic equivalent of the *Extension Condition*).

As stated, at the core of the clause (and at the bottom of the syntactic structure) VP is headed by the main verb, the predicate, which selects and assigns θ -roles to its objects; right on top of that vP is projected and selects the Agent argument. Furthermore, adverbials that have scope over the 'thematics' of the clause, such as manner and place adverbials, are adjuncts of vP; they are optional XPs that are either left- or right-adjoined to vP (they are, however, standardly referred to as 'VP-adverbials'). Thus, together vP and VP are the projection of the total thematic structure. I shall therefore group them together as the VPdomain, the semantic/thematic core. On top of the VP-domain, a temporal domain is projected/merged, namely TP. But this is also the locus of information about (negative) polarity, active/passive voice, and the subject-predicate relation (among other things). All of these elements have influence on inflection and agreement, and (for historical reasons) this domain is referred to as the IP-domain (IP being short for Inflection Phrase). I shall argue that the IP-domain consists of more than one projection, namely (at least) FinP (finiteness), NegP (negation), and TP (tense). At the top of the clausal spine, the CP-domain is located, which encodes information about e.g. illocutionary force, topic, and focus, that is, pragmatic / discourse-related information. In this way, the IP-domain 'looks' inwards (downwards) into the thematic core of the clause, whereas the CP-domain 'looks' outwards (upwards) into the universe of discourse.



1.2.5 Phases & Projections

These two principles of selection and projection provide the mechanics of the building of the clause and the composition of meaning, respectively. A way to incorporate the two is to assume that the derivation takes place in chunks or *phases* (cf. Chomsky 2001, 2004, 2005, to appear; Adger 2003; Platzack 2001*a*; Radford 2004). At the end of each phase, the semantic

features undergo Transfer to LF, and the phonological features undergo Transfer to PF. There is thus mapping from structure to meaning and sound at the end of each phase. I shall return to derivation in phases at various points (see e.g. chapter 2, section 2.3; chapter 3, section 3.3); here, it will suffice to say that CP and vP are 'strong' phases which means that in order to be accessible to probes outside the phase, say, T°, the goal must be outside the domain of the phase head. In other words, to be accessible they have to be at the *edge* of the phase, namely, either in v°/C° , in a specifier of v°/C° , or adjoined to vP/CP; in short, above v' or C'. This requirement is called the *Phase Impenetrability Condition*:

(21) **Phase Impenetrability Condition PIC**

The c-command domain of a phase head is impenetrable to an external probe (i.e. a goal which is c-commanded by the head of a phase is impenetrable to any probe c-commanding the phase. (Radford 2004: 382, (1))

This is also the reason why I shall argue (in chapter 2, section 2.3) that *v*P has more than one specifier; there has to be an 'escape hatch' for phrasal movement out of *v*P, and as the Agent already occupies a speicifier of *v*P, a second (outer) specifier is needed (see e.g. Adger 2003: 376-407 and Radford 2004: 381-431 for overviews and empirical arguments for cyclic movement through spec-*v*P and spec-CP). This role as 'escape hatch' makes it difficult to maintain a 'subject' role for specifiers, which historically underlies the EPP label. This extra 'edge position' is optional and has no theta role. What makes this position available is "an EPP-feature in standard terminology, or from another point of view, the feature OCC that means 'I must have an occurrence of some β .' Optimally, OCC should be available only when necessary, that is, when it contributes to an outcome at [LF] that is not otherwise expressible" (Chomsky 2004: 112). In other words, OCC is the 'escape hatch'.

After Transfer, the domain of the strong phase head is no longer accessible to further computation; it has been deleted from the work space. Platzack (2001*a*) argues that there is also mapping at the level of the IP-domain (see also Diesing 1997). At this stage, the structure is mapped unto what Platzack (2001*a*) calls 'Grammatical Form' which includes (at least) the subject-predicate relation, tense, voice, and polarity. Assuming this to be correct and assuming that IP-domain is not a strong phase, there is Transfer to the interfaces at the completion of the highest projection in the IP-domain but the processed syntactic representation is not deleted and, hence, is available for further structure building.²

² Conceivably, there is only mapping to meaning (LF), not to sound (PF).

Focusing on narrow syntax, the derivation form LA to LF, there is thus structure-tomeaning mapping, or *interfacing*, at three stages during the derivation. This multiple interface system will be central much of the argumentation throughout this paper.



(Where the distinction between Platzack's (2001*a*) Discourse Form, Grammatical Form, and Thematic Form is not crucial, they are subsumed under the label of LF, Logical Form.)

1.2.6 Optimality Theory

In Optimality Theory (OT) (Grimshaw 1995, Kager 1999, Prince & Smolensky 1993, Vikner 2001), the various syntactic constraints are universal but hierarchically ranked such that (the effect of) their influence may sometimes be hidden.

An OT grammar consists of two parts: the generator (GEN) and the evaluator (EVAL). GEN consists of the principles that are *inviolable*, such as X-bar-structure, and takes input from the lexicon and generates a set of competing candidates which in turn becomes the input for EVAL, which is the language-specific ordering of the universal set of *violable* constraints corresponding to parameter settings. The output of EVAL is the optimal candidate, i.e. the grammatical output string corresponding to the lexico-semantic input.

(23) input \rightarrow GEN \rightarrow {candidate₁, candidate₂, candidate₃, candidate₄ ...} \rightarrow EVAL \rightarrow output

I shall depart from standard assumptions and assume GEN to be C_{HL} (including some language specific parameter settings) (in the next section I shall present arguments justifying this departure). I shall assume that the candidate set consists of competing representations

(phrase structures) that are build from the same numeration / lexical array (the set of words and abstract features, cf. Chomsky 1998: 13-14) and share the same LF representation and have "non-distinct logical forms, in a sense which must be made precise by further research, but which certainly must entail that they are truth functionally equivalent" (Grimshaw 1995: 3). "The hypothesis is that C-I incorporates a dual semantics, with generalized argument structure as one component, the other being discourse-related and scope properties" (Chomsky, to appear: 7; see also the figure in (1) above). The constraints I shall apply are primarily information structure constraints.



To illustrate the competition between competing candidates and the ranking of the constraints in EVAL they are represented as a *tableau* as in (25) below.

(25)	Tableau:	Ranking / priority:	Higl	Higher -		→ Lower	
	Candidate set↓	Constraint hierarchy (EVAL) \rightarrow	CON1	CON ₂	CON ₃	CON ₄	
r 1	Candidate ₁			*	*		
2	Candidate ₂		*!				
3	Candidate ₃		*!	*		*	
4	Candidate ₄			**!			

In the tableau, rear marks the optimal candidate, i.e. the grammatical string, which the one that best satisfies the constraint ranking. An asterisk * marks a constraint violation, and *! marks a fatal constraint violation. Violations of lower ranked constraints are tolerated in order to satisfy higher ranked constraints, compare candidates 1 and 2. This is due to the *Principle of Strict Domination*:

(26) Strict Domination

Violations of higher ranked constraints cannot be compensated for by satisfaction of lower ranked constraints (Kager 1999: 22, (31)).

The candidate that has the smallest number of violations of a certain constraint wins over other candidates with more violations (compare candidates 1 and 4). Constraints that are not ranked with respect to each other have the same priority. They are thus ranked at the same level, see for example CON_3 and CON_4 in (25); there is no vertical line between them in the tableau. Shaded (grey) cells indicate that possible violations are not crucial, due to violations of higher constraints.

Constraint interaction and language specific constraint ranking determines the specific point in the derivation where spell-out takes place, i.e. where the structure is sent to PF.

1.2.7 Systemic Discontinuity

This section goes a little 'beyond explanatory adequacy', "asking not only *what* the properties of language are but also *why* they are that way" (Chomsky 2004: 105) – the ultimate goal of the minimalist program. This has already been touched upon in connection with the general principles of economy and constraints on computation.

The brief introduction to OT together with the modifications I propose may seem to imply that linguistic competence is not internally systemically coherent. That is not the case. The point is that certain, but far from all, syntactic operations may be motivated by constraints on, strictly speaking, non-syntactic representations, namely, information structure (such as, scope) and prosody (e.g. pronominal object shift, see chapter 2, section 2.5). Syntax (the computational system of human language, C_{HL}) and information structure are at two different levels of granularity (for example, distinctive features in the former and Topic and Comment in the latter) and abstraction (mechanics vs. meaning) but may ultimately be accounted for by quite similar grammatical systems.

Linguistic representations and systems may be analyzed with varying detail and levels of abstraction, for example on a continuum from simple and easily detectable structural principles (information structure, such as the topic-comment distinction) to some point where the system approaches deterministic chaos (e.g. massive cyclic movement or recursive Merge in UG)³. Crucially, the systems and the representations they generate are not incompatible.

Take, for example, the basic word order in Danish or English; in isolation, and at first sight, it may (or may not) suffice to say that Danish and English are SVO languages (there are obviously complications), or even that Danish is a Topic-Comment language (topic, or

³ Deterministic chaos is not the same as absolute chaos which is the same as randomness. Deterministic chaos is generated by a simple rule system or a formula and it is the prominent effect of nonlinear dynamics. The output pattern is dependent on the initial conditions, the trajectory, and small changes can have large-scale effects.

given/old information, precedes comment, or new information). However, when comparing many different languages, things get far more complicated and a much more complex grammatical system is needed. The two systems are not incompatible; they are just on different levels of abstraction and granularity.

Consider also the Fibonacci sequence and fractals (as in e.g. ice crystals; see also the fractal on the title page of this chapter) which at the outset are easy to keep track of but after a few iterations become very complex and the derivational history and constituency relations become 'blurred' (see Saddy & Uriagereka 2004: 387-388 and Jenkins 2000: 147-151, 156-158). Fibonacci numbers underlie the developmental plan and growth patterns of plants, e.g. the number and angles of spirals of seeds in e.g. the heads of sunflowers, scales on pine cones and pine apples, the branching patterns of some trees and plants, such as the common sneezewort (Danish *nyse-røllike*).

(27) The *Fibonacci* sequence

a.	Numbers:	1, 1, 2, 3, 5, 8, 13, 21, 44, 65
b.	Phrase structure grammar:	$0 \rightarrow 1$
		$1 \rightarrow 1^{\circ}0$
b.	Equation:	$x_n = x_{n-1} + x_{n-2}, n > 2$



(28) Fibonacci structure and numbers

The two underlined "101" sequences illustrate the difficulty in detecting constituency from the surface string. The left one does not form a constituent at any level (n) whereas the right one does from level n=7.

With many more iterations, an interesting pattern occurs:

(29)



"The plot above shows the first 511 terms of the Fibonacci sequence represented in binary, revealing an interesting pattern of hollow and filled triangles" (from Mathworld 1999*a*; image mirrored horizontally).

The Fibonacci grammar is a generative grammar, a recursive phrase-structure grammar, but not one that is complex enough to handle long-distance dependencies. It only requires a Merge operation, not a Move. A possible candidate for a generative system which also has a Move (or Copy, see footnote 1) operation is DNA.

Alternatively, the two systems can be seen as *discontinuous but compatible* on a par with abrupt ('catastrophic') changes in other organic systems. Take for example the abrupt changes of water when it is boiled and frozen. These changes are examples of *phase transitions*. Obviously, the three instantiations of H_2O are not incompatible – they are discontinuous.

(30) Phase transitions, H_2O



The term *phase* refers here to something other than language. However, I would like to point out that there is in fact a strong parallel between phase-transitions in, say, H_2O and the different levels of abstraction in the study of language:⁴

(31) Phase transitions, Language



The transition from information-structure to syntax is abrupt and so is the step from syntax to neurology (they are at different levels of biological abstraction, cf. chapter 4, section 4.4 on modularity and implementation). In fact, there is even a certain parallelism between the phase-transitions in physics and the syntax-internal derivational phases. At crucial points in both processes, drastic structural changes take place. In syntax, I shall argue, these changes include the licensing of multiple specifiers and the triggering of cyclic overt/covert operator movement (see chapter 2, section 2.3). Furthermore, syntactic phases, physical phase-transitions, as well as the proposed phase-transition between syntax and information structure are all symmetry breaking processes; in a sense they all have representational / structural consequences (cf. section 1.2.3 above).

At present, science has no satisfactory explanation for phase-transitions:

⁴ The model in (31) should not be taken to suggest that the 'path' from the mind to the brain necessarily goes through language. There are, of course, other 'paths', such as the visual system or the auditory system.

(32) There is not a single atom or molecule for which we can mathematically prove that is should crystallize at low temperature. These problems are just too hard for us. [...] There are ways out, of course, but they require that your relation to reality be altered in one way or the other. Either you consider a mathematical problem analogous to the one you cannot handle, but easier, and forget about the close contact with physical reality. Or you stick with physical reality but idealize it differently (often at the cost of forgetting about mathematical rigor or logical consistency). Both approaches have been used to try to understand phase transitions, and both approaches have been very fruitful. [...] Still the situation is not quite satisfactory. We should like a general conceptual understanding of why there are phase transitions, and this, for the moment, escapes us. (Ruelle 1991; cited from Jenkins 2000: 16-17)

Likewise, the fact that OT-constraint on information structure and syntactic constraints in C_{HL} are not straight-forwardly similar, they may still be compatible; also, they may or may not be systemically continuous. This is a hard problem that has to be left for future research to answer. The main point is that it need not be (theoretically) inconsistent or even problematic to use both the computational system C_{HL} with hard and fast principles and the OT system with conflicting constraints; they apply to two different (but compatible) levels of the linguistic representation which are necessarily present at the same time.

In this section, I have outlined the general theory of the language faculty and its architecture. Negation is the empirical phenomenon to which I shall apply the system. This is the reason why I shall discuss negation in more detail in the following section.

1.3 Negation

1.3.1 Negation as a Universal Category

"All human systems of communication contain a representation of negation. No animal communication system includes negative utterances, and consequently none possesses a means for assigning truth value, for lying, for irony, or for coping with false or contradictory statements [...]" (Horn 2001: xiii). That is, negation is a universal linguistic category: All languages have the concept of negation. Even if the negative operator itself (e.g. English *not*) is excluded, the concept of negation is presupposed by many other elements. For example,
verbs such as *deny* and *refuse* that take non-interrogative clausal complements and license negative polarity items (NPI, elements that require a negative, or interrogative, context, such as *at all, ever*, and *anything*)⁵, involve negation of alternatives. The same holds for prepositions such as *without*.

(33) a. He <u>denied</u> that he had done it.
→ He claimed that he had **not** done it.
b. He <u>refused</u> to do it.
→ He did **not** do it.
c. You must live <u>without</u> killing.
→ Thou shalt **not** kill.

Counter-factives, as in (34)a, and irrealis modality predicates, as in (34)b, also presuppose negation:

The conditional complementizer *if* presupposes that the condition may or may **not** be true:

(35) <u>If</u> that is true then we are in trouble.
→ It may or may not be true.

Another example is the simple fact that something can be wrong, i.e. not right:

(36) Stealing is wrong.
→ Stealing is not right.

Further examples include children playing pretend, irony and sarcasm, lies and deceit, etc.

Thus, negation is undoubtedly in the language of thought (LOT) and therefore it must also be in LF, as the feature [Neg], and in turn, therefore also in the syntax and hence, also in

⁵ NPIs may also be licensed by non-negative verbs; for example, *wonder* also licenses NPIs but it selects an interrogative clause as its object: *I wonder* [*whether he she knew* / *if she knew*].

the lexicon; recall that the LF representation is derived from a lexical array LA taken from the lexicon. As universal (functional) categories project (e.g. tense and TP, see Sigurðsson 2003), there is also a universal NegP. Due to recoverability in interpretation and learnability, at least one or both of spec-Neg and Neg^o must be realized overtly (see chapter 2, section 2.4.2) (this is probably what drives *Jespersen's Cycle*, Jespersen 1917; see chapter 3, sections 3.2.5 and 3.2.6).

Smith et al. (1993) has tried to teach Christopher (an autistic man with extraordinary linguistic abilities in the face of severe mental retardation) an artificial language which they call *Epun*. This artificial language does not have a negation marker and thus deviate from the principles of universal grammar UG. Instead, negation is expressed with word order: In negative clauses the verb precedes the subject, and past tense is realized by fronting the object:

(37)	a. Positive (Present and Future):		Subj	Verb Obj
	b. Positive (Past):	Obj	Subj	Verb
	c. Negative (Present and Future):		Verb Subj	Obj
	d. Negative (Past):	Obj	Verb Subj	

Though the system seems fairly simple, neither Christopher nor the normal controls were able to learn it. On the other hand, this would most likely be easy for an artificial neural network to learn as it operates on statistics and, unlike human language users, structure-independently. A human language, i.e. one that satisfies the principles of UG, on the other hand, must have a negation marker.

1.3.2 Types of Negation

This is a very brief introduction to negation. The point is to establish sentential negation which will be one of the main topics of this dissertation. For a comprehensive analysis of negation, see e.g. Horn (2001) and Haegeman (1995).

Basically, I shall argue that there are three different types of negation, namely (i) **sentential negation** which is realized in the clausal spine as NegP positioned between FinP and TP (sentential negation has wide scope: it negates the whole clause); (ii) **constituent negation** which has narrow scope (it does not negate the clause, only constituents such as DPs and PPs); (iii) **meta negation** which has neither constituent / narrow scope nor sentential / wide scope; It has scopes over more than the clause, so in a sense it has the widest possible

scope. These three types of negation have different structural positions in the syntactic tree, but sentential negation is part of the clausal spine; meta-negation is outside or above it, while constituent negation can be anywhere else, for example below it on a DP object (see e.g. Zanuttini 1997 and Cormack & Smith 2002 for analyses with multiple NegPs.) The scope of the negative operators is their c-command domain:



1.3.2.1 Sentential Negation

The scope of negation can be tested with, for example, an opposite truth value test, positive and negative tags, and negative polarity items.

A negative sentence has the **opposite truth value** of the corresponding sentence without negation: If X is true, then the negation of X (\neg X) is necessarily false; and if X is false, then \neg X is necessarily true. For example, if (39)a is true, the (39)b is necessarily false, and vice versa:

Opposite truth values is a *necessary* but not a *sufficient* condition on sentential negation. Clauses with opposite truth values need not be a clause (X) and its negated counterpart (\neg X). For example, if (40)a is true, then (40)b must be false, and vice versa, but the cannot possibly be described as a clause and it negated counterpart. This becomes even more clear when (40)c is taken into consideration. Only one of the three can be true at a time, but neither (40)b or c means the same as (40)d which is the real negative counterpart of (40)a. Furthermore, if (40)a is false and (40)d is true, it does not necessarily follow that either (40)b or c are true; (40)a, b, and c may all be false at the same time.

(40) a. Gunnar is in Oslo.
b. Gunnar is in Baghdad.
c. Gunnar is in Sweden.
d. Gunnar is not in Oslo

Negative sentences take positive tag-questions, such as *will I*? or negative elliptic conjuncts, such as *and neither will you*, as in (41)a and (42)a, respectively, while such tags are incompatible with positive polarity, as in (41)b and (42)b:

(Negative)	will I?	it right,	<u>not</u> get it	will	I	(41) a.
(Positive)	will I?	it right,	get it	will	*I	b.
(Negative)	and neither will you.	it right,	<u>not</u> get it	will	I	(42) a.
(Positive)	and neither will you.	it right,	get it	will	*I	b.

Likewise, positive sentences take negative tag-questions, such as *won't I*? or positive elliptic conjuncts, such as *and so will you*, while such tags are incompatible with negative polarity:

(43) a. *I will <u>not</u> get it right, <u>won't I</u>? (Negative)
b. I will get it right, <u>won't I</u>? (Positive)
(44) a. *I will <u>not</u> get it right, <u>and so will you</u>. (Negative)
b. I will get it right, <u>and so will you</u>. (Positive)

Furthermore, negative sentences take negative polarity items (NPIs):

(45)	a.	I	will	not	get	it	right	at	all.	(Negative)
	b.	*I	will		get	it	right	at	all.	(Positive)

Like the opposite truth values test, NPI licensing is a necessary but not sufficient condition, as NPIs can be licensed in interrogative contexts as well, regardless of polarity:

To summarize, a negative sentence (i) is the counterpart of the same sentence without negation, (ii) takes positive tag-questions (*will I*?) and negative conjuncts (*and neither...*), and (ii) disallows negative tag-questions (*won't I*?) and positive conjuncts (*and so...*), and (iv) allows negative polarity items (NPIs).

1.3.2.2 Constituent Negation

Constituent negation has narrow scope compared to the wide scope of sentential negation; it scopes over e.g. an NP, an AdvP, a small clause or a VP:

(NP)	ith [not [NP too many errors]], this should work.	47) a.	(47
(AdvP)	Not $[AdvP long ago]$, Arnold spoke German.	b.	
(Small clause)	Not $[sc making it in time]]$ is really irritating.	с.	
(VP)	shall [not [$_{VP}$ author a book]], but write an essay	d.	

Constituent negation fails in all the tests that sentential negation passed, and passes the ones sentential negation failed.

A clause with constituent negation does not have the opposite truth value of the corresponding clause with out negation: (48)a is not incompatible with (48)b and they can both be true at the same time. The true negative counterpart of (48)a is (48)c.

(Constituent negation)	German.	spoke		Arnold	ago,	long	Not	(48) a.
(Positive)	German.	spoke		Arnold	ago,	Long		b.
(Sentential negation)	German.	speak	did <u>n't</u>	Arnold	ago,	long	Not	c.

Constituent negation does not license negative tags, neither positive tag-questions, as in (49)a, nor negative tag-clauses, as in (49)b. This means that the negative operator clearly does not scope over the clause.

(49) a. *<u>Not</u> long ago, Arnold spoke German, <u>did he</u>?
 b. *<u>Not</u> long ago, Arnold spoke German, <u>and neither did I</u>.

In contrast, constituent negation is compatible with positive tags, both negative tagquestions, as in (50)a, and positive tag-clauses, as in (50)b. Again, this is a strong indication that the clause as such is not negative.

a. <u>Not</u> long ago, Arnold spoke German, <u>didn't he</u>?
b. <u>Not</u> long ago, Arnold spoke German, <u>and so did I</u>.

Finally, unlike negation with sentential scope, constituent negation does not license NPIs:

a. *Not long ago, Arnold spoke German at all.
 b. *Not long ago, Arnold spoke German in any way.

1.3.2.3 Meta-negation

As stated above, meta-negation has a wider scope than the wide scope of sentential negation. Meta-negation is not the same as sentential negation. It selects a CP (which can be either declarative, as in (52)a and (53)a, or interrogative, as in (52)b and (53)b) or a PP, (52)c and (53)c, not a TP or even a FinP, as in (52)d and (53)d:

```
(52)
       En: a.
               [Not [CP that it would do any good]]
           b.
                [Not [CP if I can help it]]
                [Not [PP in this life]]
           с.
            d. *[Not [FinP John left]]
(53)
                [Ikke [CP at det ikke nytter
       Da: a.
                                                    noget]]
                          that it not is.of.use any
                 Not
                "Not that it doesn't help."
                [Ikke [CP om jeg gider at høre mere om
           b.
                                                             det]]
                                 bother to hear more about it
                          if I
                 Not
                "I simply don't want to hear more about it"
```

c. [Ikke [PP på vilkår]] Not on conditions "Under no circumstances!" d. *[Ikke [FinP Peter gik]]

Not

Peter left

Note that it selects a subordinate clause. This is particularly clear in the Danish examples because the embedded word order is different from the one in main clauses. Finite verbs move to C^o (second position) in main clauses but remain in situ in embedded clauses and thus follow sentential adverbials and negation. Meta-negation cannot be fronted/topicalized sentential negation because (i) topicalization only takes place in (matrix and embedded) **main** clauses, and (ii) because topicalization of negation is otherwise impossible in Danish and English (see chapter 3, section 3.2).

(54) a. En: *Not have I done that.b. Da: *Ikke har jeg gjort det.

Interestingly though, meta-negation passes the tests for sentential negation and fails the tests for positive polarity:

(55) En: [Not [_{CP} that I trust them]]

a. \neq I trust them	(Opposite truth value)
b would I?	(Positive interrogative tag)
c *wouldn't I?	(Negative interrogative tag)
d but neither do you.	(Negative declarative tag)
e *but so do you.	(Positive declarative tag)
f in any way at all.	(Licenses NPI)

Further evidence for the special status of meta-negation is the fact that it cannot be a complement clause, cf. (56)a; it can only be a parenthetical adjunct as in (57).

(56) En: a. *He believed [not that he could trust them] (Meta-neg)b. He believed that he could not trust them (Sentential neg.)

Because meta-negation cannot be the same as sentential negation, I shall disregard it in my analysis of topicalization of negation in chapter 3.

1.3.3 Summary

I have argued that all human languages have a syntactic reflex of the concept of negation; the negative feature [Neg] is part of universal grammar UG. This is important for the argument for the NEG-criterion in chapter 2, section 2.4.2, stating that negation must be overtly realized; NegP must have overt material, either in Neg^o, spec-NegP or both (however, as I shall argue, this is violable to some extent). I have discussed a set of tests that may be used to determine the scope of negation and to distinguish between sentential negation and constituent negation. Both constituent and meta-negation shall be disregarded in the analysis of NEG-topicalization in chapter 3. Unless stated otherwise, in all the examples in the following chapters, negation has sentential scope, i.e. it is sentential negation.

Sentential negation is reflected in the syntax as the unique NegP projection in the clausal spine between FinP and TP. The specifier of NegP, spec-NegP, I shall argue, is the target of NEG-shift (cf. chapter 2).

1.4 Long-distance Dependencies and Abstract Elements

In this chapter I shall go a bit beyond linguistic description and explanation and argue that displacement (i.e. syntactic movement) is in fact found in many linguistic theories that otherwise explicitly avoid movement. Furthermore, abstract entities such as empty categories (traces *t*, PRO, OP) are not just artefacts of formal linguistic theory but are ubiquitous and standardly assumed in order to account for phenomena in mathematics, biology, chemistry, physics, astronomy, etc. Therefore linguistics can be unified with the rest of the sciences and thus avoid what Chomsky calls *methodological dualism*:

(58) The view that we must abandon scientific rationality when we study humans 'above the neck' (metaphorically speaking), becoming mystics in this unique domain, imposing arbitrary stipulations a priori demands of a sort that would never be contemplated in the sciences, or in other ways departing from normal canons of inquiry. (Chomsky 1994: 182) (59) Displacement and traces in generative grammar (section 1.2.2; also chapters 2 and 3)

Displacement in linguistic theories (section 1.4.1)

Abstract entities in the natural sciences (section 1.4.2)

1.4.1 Linguistic Theories and Syntactic Movement

It is an empirical fact that human language has syntactic structure: For example, syntactic displacement is structure-dependent; it operates on constituents which may in turn be made up of other constituents and so forth. That is, syntactic structure-building is recursive. Furthermore, any theory of syntactic structure must take into account displacement and long distance dependency – i.e. movement and trace-antecedent relations. It is also simply an empirical fact that constituents may occur in 'non-canonical' positions, that is, that constituents may undergo movement. In other words, any theory must have some notion that corresponds to *traces* (or copies) in generative grammar. Thus, though it is not a waste of time motivating a displacement analysis of word order differences between two sentences A and B, where A has movement while B does not, motivating the existence of displacement itself is:⁶

(60) For over forty years, there have been efforts to motivate displacement. That seems to be a mistake. Recourse to any device to account for the displacement phenomena also is mistaken, unless it is independently motivated (as is internal Merge). If this is correct, then the radically simplified form of transformational grammar that has become familiar ("Move-a" and its variants) is a kind of conceptual necessity, given the undeniable existence of the displacement phenomena. (Chomsky 2004: 125, fn. 29; emphasis added)

The point of this section is to show that there should be much more consensus about such theoretical matters, and syntactic movement in particular, as in many cases it all seems to boil down to a matter of personal preferences for certain research perspectives.

 $[\]downarrow$

⁶ In the quote in (60), *internal Merge* refers to the same as *Move* (see footnote 1). The difference between external Merge (EM) and internal Merge (IM) is that EM merges an element external to the structure already built, i.e. from the lexical array LA, whereas IM re-merges an element from within the structure, i.e. an element that has already been merged.

(61) [T]hese are differences in opinion of the kind that appear in all the sciences about what's the proper way of capturing an obscure array of phenomena which we only partially understand. In fields like linguistics, which are sort of peripheral to the sciences, these become battles, but that's just childish. There are just very similar ways of looking at things which differ on certain assumptions. To turn them into a war is ludicrous.

[...] [T]here are elements of the culture of the humanities and the social sciences which are very harmful, which one should keep away from. That is where people stake out a claim to a theory or a field or an explanation, or something, and have to defend it against all comers. That's totally foreign to the spirit of the sciences or to the spirit of rationality generally. And that's just too bad. I mean, if there's something to be learnt from other approaches, then it is learnt. And if some other approach turns out to be correct, fine. (Interview with Chomsky, Andor 2004: 95-96; emphasis added)

In what follows I give an (admittedly perhaps unjustly brief) overview of some alternative syntactic approaches.

1.4.1.1 Field Analysis

Contrary to some claims, the *topological analysis* or *field analysis* (Diderichsen 1946, Hansen 1984, Heltoft 1986, Jørgensen 2000, Preisler 1997, Togeby 2003; see also Allan et al. 1995) has something that corresponds to movement. As the focus is on description, it would seem that the field analysis has very little to offer by way of explanation. Nonetheless, there is something that corresponds to movement, though the mechanism is often employed for pedagogical reasons. For example: "In most cases, we can use **movement** to the pre-field as a test to show the size of the constituents of the clause: what moves together is one and only one constituent" (Hansen 1984: 55; my translation, emphasis added). This movement (which corresponds to movement) is thus used to account for hierarchical structure and constituency which are also core concepts in generative grammar.

Conjunc- tion	Pre- field	Nexus-field					Conter	Extra pos.		
		V	n	light	a	neg.	V	Ν	Α	
	-	Køber	du	den	så	ikke	-	-	til hende?	
		Buy	you	it	then	not			for her	
Men	han	har	-	-	virkelig	ikke	sagt	noget	længe	
But	he	has			really	not	said	anything	for.long	
Og	hun	har	-	-	sikkert	aldrig	lånt	ham den	før	
And	she	has			probably	never	lent	him it	before	
	-	Har	du	-	virkelig	ingen	set?	-		
		Have	you		really	none	seen			
Sometimes filled by movement, v from V, light and neg from N (obj) or A (adv)										
				Left er e.g. fro V+N (*	npty or fille om n (subj), verb and ob	a (adv), ject), V+	vement, N (obj) N+A (v	of A (adv) verb, object	, , and advberb	ial)

(62) Diderichsen's main clause analysis

Slots normally associated with a fronted or extraposed element must be empty: If, say, the object is fronted (moved to the pre-field), the N slot must be empty. This corresponds to traceantecedent chains where the trace blocks elements from being inserted into the same position. The extraposition is filled, e.g. by 'Heavy-NP shift' (right-dislocation, cf. chapter 2, section 2.3.7.2): "Italics mark a heavy **moved** constituent or part of constituent, and the empty parentheses indicate the **normal** position." (Hansen 1984: 61)

Note the strong parallel to traces and empty categories in Generative Grammar.

The negation field is filled by a negative adverbial such as *ikke* 'not' or *aldrig* 'never', but is can also be filled by movement, namely, by what I shall refer to as NEG-shift (see chapter 2): "Objects, predicates and adverbials that contain negation are not placed in the **normal** positions for these types of constituents" (Hansen 1984: 58). Thus, the negation field corresponds to spec-NegP in the generative phrase structure.

The light field is filled by object shift (chapter 2, sections 2.3.3 and 2.5): "They [the *object-shifted* pronominals] are thus not in the position in the field schema which they should be affiliated with by their **relational functions**, but [cliticized onto the element] in the closest filled position [to its left, except adverbials]" (Jørgensen 2000: 87).

Finally, the v field, which corresponds to C^o in the generative grammar, is filled by head movement, e.g. in inversion. "Partial inversion is a type of inversion where only the finite

verb (the first verb from the left, in visual terms) is **moved** to the left of the subject" (Preisler 1997: 51).

One disadvantage of the field analysis is that it does not reflect hierarchical clausal structure (apart from the fields). Another is that different topological schemes are assumed for main and embedded clauses as well as for different languages. (See Vikner 1999 for a comparison of the field analysis with the generative tree structure. See Platzack 1985 and Heltoft 1986 for unified schemas for main and embedded clauses; see also (72).) The following schema (adapted from Wöllstein-Leisten et al. 1997: 53) is the equivalent field schema for German (see Diderichsen 1941 for a field analysis of Old Norse):

Pre-field (Vorfeld)	Left Sentence Bracket (Linke Satz- klammer)	Middl (Mittel	e Field lfeld)	Right Sentence Bracket (Rechte Satz- klammer)	Post-field (Nachfeld)
ХР	Finite verb / complementizer	Light	Subj, IO, DO	Infinitive / Finite Verb	Extra- position
Heinz <i>Heinz</i>	liegt <i>lies</i>		auf dem Sofa on the Sofa		
Wem <i>Who</i> .DAT	hat <i>has</i>	<i>er</i> he	gestern einen Brief <i>yesterday</i> a.ACC <i>letter</i>	geschrieben? Written	
Die Männer <i>The men</i>	wird will		nicht mein Auto Morgens not my car tomorrow	Fahren können drive can	
	dass that	<i>sie</i> she	schon ein neues Auto <i>already a new car</i>	gekauft hat bought has	
	weil <i>because</i>		Dieter froh <i>Dieter happy</i>	Ist is	
Only filled by movement		Re-or	dered by Scrambling	Only filled - by movemen	t

(64) German field analysis

Sometimes filled by movement from Right Sentence Bracket

1.4.1.2 Lexical Functional Grammar (LFG)

Lexical Functional Grammar (LFG) (e.g. Bresnan 2000, 2001, Kroeger 2004, Sells 2000) is non-derivational formal approach that supposedly does not have movement operations:

(65) First, the extended X' theory of LFG is lexicalized, in the sense that every syntactic category X represents a lexical class. [...] Hence, nothing ever moves to I or C; if there is evidence for an element occupying a special head position such as I or C, it is base-generated in I or C. Second, the extended X' theory of LFG is nonderivational: the effects of movement in X' trees arise from the fact that different *c-structure* [constituent structure, K.R.C.] positions may correspond to the same f-

structure [functional structure, K.R.C.] *by general principles of correspondence between parallel structures* (Bresnan 2000: 10-11; emphasis added).

However, there are empty categories that correspond more or less to the generative notion of traces and mappings that resemble co-indexing. For example, verb movement:

(66) Which positions it actually appears in depends not on movement (the paired structures are generated without movement), but on correspondence. [...] While movement configurations coindex one lexically filled position with a chain of empty ones, imperfect correspondence allows for 'coindexing' (formally, a correspondence mapping) between multiple lexically filled positions (Bresnan 2000:4).

There is thus **base-generation** and **one-to-many mapping**. For example, a fronted object, as in *this book I really don't like*, has the topic function, by virtue of its structural position, and the object relation required by subcategorization of the transitive verb. Some proponents of LFG (e.g. Sells 2000) argue that there is no gap position corresponding to the object position after the verb. Others argue that it is an empirical question and that it may in fact be subject to parametric variation: "In the present framework [...], empty categories can appear as a "last resort" in highly configurational languages which lack other means of specifying functions" (Bresnan 2001: 92).

(67) We have assumed [...] that all c-structure [constituent structure, K.R.C] categories are optional and are present only if required by general principles such as completeness or coherence. We have further hypothesized that the presence of or absence of of c-structure gaps in the English and Russian examples of topicalization, illustrated in [(68)a and b], is **typological** [i.e. parameterized, K.R.C.]. Russian has no need for the empty category in its clause-internal topicalizations, because it employs lexocentric principles of function specification in addition to the purely configurational endocentric principles. English, in contrast, cannot do without the endocentric principles. **Empty categories are pressed into service in English as a** "last resort," to secure completeness and coherence when there is no other means of function specification available. (Bresnan 2001: 188; emphasis added)

As far as I can tell, this view of UG simply shifts the problem of acquisition from learning whether a language has a particular movement or not to learning whether a language has one-to-many mappings or not as well as whether it has empty categories or not.

1.4.1.3 Functional Grammar (FG)

Simon C. Dik's (1989/1997) Functional Grammar (FG) is in many ways similar to the generative perspective on language, especially the minimalist program (e.g. Chomsky 1995, 2001), in spite of the opposition implied in the name. For example, FG is constrained by a set of principles or constraints, one of which is Avoid Transformations (Dik 1997: 18 also acknowledges that generative grammarians no longer endorse transformations.): "In other words, a derivation is a matter of gradual expansion rather than a transformational mapping of one structure onto another" (Dik 1997: 19). The derivation builds a representation in a bottom-up manner by adding what is strikingly similar to specifiers and adjoined modifiers:

(69) Starting from the nuclear predication, the full structure of the clause can be built up layer by layer, by specifying grammatical operators "π" and lexical satellites "σ" appropriate to the given layer. Operators concern distinctions which are lexically expressed in the language concerned, satellites are modifications which are lexically expressed. Satellites largely coincide with "adverbial modifiers." (Dik 1997: 51; emphasis added)

Operators (π) correspond (more or less) to heads (X°s) in generative grammar, while satellites (σ) correspond to either specifiers or adjuncts.

The derivation results in an "underlying clause structure" which is mapped onto expression. Note the strong similarity between FG's 'expression rules' and the generative 'spell-out' (note also the parallel between "underlying clause structure" in FG and Deep Structure in Government & Binding Theory, Chomsky 1981 (see also Uriagereka 1999*a* for a defense of deep structure within minimalism)):

(70) The structures in the predicate frame constitute the input to a number of operations[...] which result in an elaborate underlying clause structure (UCS). The UCS is

subsequently mapped unto a linguistic expression by the application of expression rules, which determine both the form and the order of the elements of the underlying structure. (Kahrel 1996: 13)

I have summed up the levels or layers of the underlying clause structure in FG in the diagram in (71) below (see also Dik 1997: 67):

(71) Underlying Clause Structure in FG

<u>Lev</u> σ4: π4:	<u>vel 4: clause (speech act)</u> "briefly" illocutionary force (declarative, interrogative, imperative)										
	<u>Lev</u> σ3: π3:	el 3: r "in 1 subj	proposition (possible fact) my opinion" jective modality (evaluation, attitude)								
		<u>Lev</u> σ2: π2:	<u>rel 2: extended predication (state of affairs)</u> time, location, space tense, objective modality (time, space, cognition(?))								
			Level 1: core predication (property or relation) σ1: manner, speed, instrument, direction, beneficiary π1: (im)perfective aspect, (non-)progressive aspect (Subj, Obj)								
			Level 0: nuclear predication Predicate and terms (arguments)								

There is, however, an important difference between the application of expression rule in FG and Spell-out in minimalism. In the latter, constituents are merged and moved in order to get the right scope relations in terms of c-command. The resulting representation is then sent to Spell-out for linearization and phonological encoding. Displacement phenomena and word order variation between languages are thus accounted for in the course of derivation. In FG, on the other hand, the derivation results in an unordered (unlinearized) representation which is then subjected to a set of expression rules. It seems that word order variation is then due to different languages having different expression rules. Displacement phenomena thus need to be stated in terms of mapping relations as in LFG.

1.4.1.4 Generative Grammar

So far, a mapping from FG to Universal Grammar (UG) in generative linguistics is more or less straight-forward. The functions standardly assigned to the different projections/domains of the structure correspond more or less to the different levels of the FG model. Together, Diderichsen's field schema and Dik's FG account for the word order restrictions (linearization) and functional mapping. The tree structure in UG, however, takes care of both at once:

11	77) \
	1 4	.)

Function	UG Projection		Diderichs	en's field	schema	FG level
				Main	Emb.	
Illocutionary Force, Topic,	СР	Spec-CP	Pre-field	Pre		4
Focus, complementizers		C°	Nexus	v	Conj	
Finiteness, EPP/"nexus"	FinP	Spec-FinP	Field	n	n	3
Light pronominals	πP	Spec-πP		light		
(the "Wackernagel position")						
[adjoined to NegP:]		AdvP		adv	а	
sentential adverbials						
Negation, (Polarity,)	NegP	Spec-NegP		neg	neg	2
sentential adverbials						
Tense, Mood	ТР					
[adjoined to vP:] time, place,						
and manner adverbs						1
Proposition, Agent, transitivity	vP					
Aspect	VP _{aux}	V _{aux} °	Content		V	
Predicate, Beneficiary, Theme	VP _{main}	V _{main} ^o	Field	V	V	0
		XP		Ν	Ν	
[adjoined to vP:] time, place,		AdvP		Α	Α	1
and manner adverbs						

In Danish, time, place and manner adverbs are usually, though not always, right-adjoined to vP and are thus usually sentence final (but preceding elements in extraposition). Therefore, there are two [adjoined to vP]-slots in the table. Note that UG in generative linguistics allows for many more positions than the Diderichsonian field schema. For example only three of (at least) eight head positions are used in Danish, namely C°, V_{aux} °, and V_{main} °, and only four specs, namely, spec-CP, spec-FinP, spec- πP , and spec-NegP.

A crucial difference between generative approaches such as *Government & Binding* (Chomsky 1981) and the *Minimalist Program* (Chomsky 1995, 2001) on the one hand and FG and LFG on the other is that in the former approaches, word order variation and displacement phenomena are handled in a principled way and explicitly, whereas in the latter frameworks such phenomena are taken care of by rather underspecified language-specific 'expression rules' in FG and by 'mappings' in LFG. The problem of accounting for syntactic

displacement is thus pushed into other domains or modules (see also Chapter 3, section 3.3.4, footnote 72) which separates movement from the elements and constraints with which should belong (see sections 1.2.1 to 1.2.5).

1.4.2 Invisible Elements and Abstract Computation

Generative linguistics (Biolinguistics) explicitly operates with a number of abstract elements that are phonetically empty. For example: traces (or 'silent' copies) left by syntactic movement, phonetically 'empty' operators (OP) such as the element is spec-CP in *yes/no* questions, and the 'understood' subject of infinitives (PRO). As stated above, other linguistic approaches explicitly avoid such elements, though they seem more or less to assume them implicitly in some for or other. Such 'invisible' or 'silent' elements that are only inferred or assumed to account for a range of observed phenomena are common in the natural sciences.

(73) Conditions on transformations, first of all, argue for their reality. It is standard in science to use the discovered properties of a hypothesized object to argue for its existence. [...] How do we know they are real? Because we predict them and once we look we find properties such as the ones embodied under the Conservation, Locality and Symmetry clauses. (Saddy & Uriagereka 2004: 391)

(The term *transformations* refer to movement operations but the point of the quotation also applies to other long-distance dependencies and 'silent' elements other than traces.)

Take for example, quarks in physics. According to Stanford Linear Accelerator Center (2003*a*), all that is presently known about them is that they probably do not have any internal structure and are smaller than 10^{-19} meters in radius. Then the question is again:

(74) If we cannot separate them out, how do we know they are there? The answer is simply that all our calculations depend on their existence and give the right answers for the experiments (Stanford Linear Accelerator Center, 2003b).

(On the reality of quarks, see also Jenkins 2000: 40-42.) The same applies historically to atoms, electrons, protons, and molecules:

(75) I mean even in physics until the 20th century, theoretical physics was regarded with scepticism. Among physicists, physics was considered primarily a field in which you

investigated qualities, relations among pressure and force and so on and found generalizations. The development of atomic theory for example, the theory of molecules, was basically the same thing. It was considered mostly a calculating device until the 20th century. Bolzano, for example, had a hard time convincing people to take seriously his belief that molecules were real things, not just devices invented in order to calculate the results of an observed reaction. (Interview with Chomsky, Andor 2004: 100)

In astronomy, we have black holes: dead stars with immense gravitation strong enough to prevent even light from escaping. Thus, a black hole cannot be observed directly as they neither emit nor reflect light – they are black. Nonetheless, there are good reasons to think they exist (cf. Cambridge Relativity & Gravitation Research 1996). Black holes are only 'observable' indirectly from the **effects** of their immense gravitational force.

Even a planet in our own solar system was inferred before it was actually observed. In 1845 John C. Adams, inferred and calculated the position on the as yet undiscovered planet Neptune from deviations in the orbital course of Uranus, which was then thought to be the outermost planet in the solar system. This led astronomers to actually search for it and eventually find it in 1846 (cf. Smith 2004).

In mathematics there are a number of abstract constants (perhaps on a different phenomenological level than the elements discussed so far). There are, for example, *irrational* numbers such as $\sqrt{2}$ (1.4142135...), π (3.1415926...), and *e* (2.7182818...) which are needed to account for geometric figures, and the so-called *imaginary* number *i* ($\sqrt{-1}$, the square root of minus one):

(76) It has, however, proved extremely fruitful and useful to enlarge the number concept to include square roots of negative numbers. The resulting objects are numbers in the sense that arithmetic and algebra can be extended to them in a simple and natural manner; they are imaginary in the sense that their relation to the physical world is less direct than that of the real numbers. (Encyclopædia Britannica Online, entry on "complex analysis"; emphasis added).

(Two of the irrationals, π and e, and the imaginary number i are all included in the Euler formula, or Euler identity: $e^{ix} = \cos x + i \sin x$, cf. Mathworld 1999*b*; see also Jenkins 2000: 45).

The irrational and imaginary numbers do not correspond to anything directly observable (yet) but they are needed to account for geometry, multiple dimensions, chaos, etc.

Abstract entities may be and have been posited to account for theoretical as well as empirical phenomena. In turn, they may motivate actual empirical search for such inferred phenomena, as has often been the case in the sciences. This is also the case with abstract silent elements such as covert categories and traces of movement in syntax. In psycholinguistics, priming studies have shown priming effects at trace positions. In other words, people are faster at recognizing strings of letters or sounds as actual words at certain positions in a sentence given a certain priming; for example, people are faster at recognizing a topicalized word if it is shown to them at positions that contain a trace of it than when presented anywhere else in the string (e.g. Bever & McElree 1988, MacDonald 1989, Nakano et al. 2002, Pinker 1994: 219-220, Roberts et al. 2004). In neurolinguistics, imaging studies using fMRI (see chapter 0, section 5.1.1) have found neural reflexes of movement phenomena (cf. chapter 0, sections 5.2 and 5.3). Certain brain areas are activated more and thus require more oxygenated blood when comprehending sentences with certain types of syntactic movement than when comprehending structures without such movement. Studies of agrammatism in Broca's aphasia have revealed movement-related comprehension problems and structuredependent production deficits (cf. chapter 0, section 0). Finally, studies of working memory have established correlations between syntactic movement and traces and the amount of working memory required in sentence processing (chapter 0, section 5.4).

1.4.3 Summary

In section 1.2.7 on systemic discontinuity I discussed parallels between deterministic chaos and phase-transitions in physics and the computational system, derivational phases. In section 1.4.2, I have discussed parallels between invisible/abstract (silent/covert) elements in syntax and invisible/abstract entities in the natural sciences. Together these parallels support the minimalist idea that the properties of the computational system are analyzable (and should be analyzed) by an apparatus subject to the same methodological constraints of the scientific method, thus avoiding methodological dualism.

While sections 1.2 and 1.3 are important for the whole dissertation, section 1.4.2 is perhaps most relevant to (but not only) chapter 4 (and 5) on neurolinguistics. As the existence of displacement and abstract computation are "undeniable", the study of syntactic movement and how it is implemented in the brain is fully justified. The choice of the biolinguistic approach (minimalist syntax) to the problem, I shall argue in chapter 4, motivated by the

compatibility of the architecture of the computational system, the nature of syntactic displacement and structure, and the structure of the brain. Given that any theory must take displacement into account, the core computational system (as outlined in sections 1.2.1 to 1.2.5, or something similar) seems to be presupposed by any theory of language. I would therefore like to claim that the results of the linguistic analyses of chapters 2 and 3 and of the neuroimaging studies presented in chapter 5 are compatible with any scientific approach to language.

Part 1:

Syntax & Negation



Illustration: *Chains*

2 Negation and Quantifiers

2.1 Road Map: NEG-shift and the Clausal Spine



(77) Position of object NegQP:

2.2 Corpus data

2.2.1 Introduction

In this chapter I give a descriptive account of word order variations in negative clauses in Danish with an indefinite object, merely touching upon subjects and adjuncts. Establishing the basic empirical facts will serve to back up my native speaker intuitions and thus ward off the potential criticism that the analyses in the following chapters are based on introspection that may differ from the norm and that I may see what I want to see.

I present data from three different corpora, two based on written texts and one on spoken Danish. The result shows that NEG-shift, i.e. movement of the object to the sentencemedial position of negation, appears to be on the retreat in Danish but it hasn't yet reached the degree it has in Norwegian where it is only found in literary texts. Furthermore, I show that the indefinite negative quantifier *ingen* 'no' need not be analyzed as an amalgamation of negation *ikke* and the indefinite quantifier *nogen* as has been proposed for Norwegian (Christensen 1986, 1987).

2.2.2 Negation, Indefinite Objects, and Word Order

In Danish, an SVO language, the object normally immediately follows the selecting verb. This is evident from object shift data. When the main verb is in V2 position, object shift is licensed such that both verb and object precedes sentence medial adverbials and negation (e.g. Vikner 1994, Holmberg & Platzack 1995; see also sections 2.3.3 and 2.5 below). This is only licensed with pronominals, not full DPs, in Danish.

```
(78)
       Da: a.
              Jeg så
                        den ikke
           b. *Jeg så
                            ikke den
               Ι
                   saw
                            not
                                 it
           с.
               Jeg har
                             ikke set
                                       den
           d. *Jeg har den ikke set
               Ι
                   have it not seen
(79)
       Da: a. *Jeg så [den gule hund] ikke
           b.
               Jeg så
                                       ikke [den gule
                                                         hund]
                                              the yellow dog
               Ι
                   saw
                                       not
```

In Danish, as in many other languages (see sections 2.3.2 and 2.4 below), a negative sentence can be constructed in two ways: one with negation and an indefinite quantifier, and another with an indefinite negative quantifier, corresponding to the English *not any / no* distinction:

(80) Da: a. Der var [<u>ikke nogen</u> trin] There were not any steps b. Der var [<u>ingen</u> trin] There were no steps

Negative objects such as *ingenting* 'nothing', *intet* 'nothing / no-NEUTER', *ingen* 'no one / no-COMMON', on the other hand, must occupy the position normally occupied by sentential negation (e.g. Hansen 1984: 58, Jørgensen 2000: 93-94, Allan et al. 1995: 515-516). That means they follow finite main verbs in V2 position but precede non-finite main verbs. This is the only context were Danish allows SOV word order (or rather S-Aux-OV in main clauses; it is only really SOV in embedded clauses where the finite verb does not move to C°). I shall refer to the movement to the position of the negation by a negative object as *NEG-shift* (this will be the main topic of section 2.4).

(81) Da: a. Jeg fik [ingenting/intet /ingen gaver] Ι got nothing /nothing/no presents b. Jeg fik ikke [noget /nogen gaver] Ι got not anything/any presents (82) Da: a. Jeg har [ingenting/intet /ingen gaver] fået have nothing nothing/no Ι presents gotten b. Jeg har ikke fået noget / nogen gaver Ι have not godten anything / any presents (83) Da: a. De vidste at jeg ingenting fik They knew that I nothing got b. De vidste at jeg ikke fik noget They knew that I not got anything

(In section 2.3.5 I discuss negative objects in situ, following the non-finite main verb, and their interpretation. Briefly, such examples are ungrammatical unless the complement of *ingen* is scalar, such as money or points.)

The two versions are (more or less) synonymous (see section 2.3.13.2). However, some speakers find the types in (82) and (83) where the object precedes the main verb, to be formal, archaic, or literary, something found in written texts, not in spoken language. Nonetheless, there are many examples of that type, in written as well as spoken Danish. Here are three authentic spoken examples (the underscore '__' indicates the canonical object position):

(84) Da: Kræfter som de [<u>ingen</u> kontrol] har _____ over Forces which they no control have over

> (Danish National Radio (DR), P1, News broadcast: *Orientering*, July 25, 2002, 11:00 am)

(85) Da: Sheiken understreger at modstandsbevægelsen har faktisk Sheik-the emphasizes that resistance-the has actually

> [<u>ingen</u> gidsler] slået _____ ihjel bortset fra en italiener no hostages slain dead except from an Italian

der arbejdede som sikkerhedsvagt for amerikanerne. Who worked as security.guard for Americans-the

(Ole Sippel live from Bagdad, Danish National TV (DR1),

News broadcast: TV-Avisen, April 21, 2004, 9:00 pm)

(86) Da: Byen er fuldkommen omringet og der kan Town.the is completely surrounded and there can

> [<u>ingen</u> forsyninger]komme _____ ind i byen no supplies come in in town.the

(News broadcast: TV2 Nyhederne, November 12, 2004, 8:00 a.m.)

(87) Da: sådan nogen der <u>ingen admiraler</u> har af gode grunde such someone that no admirals has of good reasons
 "The kind that, for good reasons, don't have any admirals"⁷ (BySoc)

⁷ In this example, it is very likely that *nogen* 'some [Plur, NPI] / someone [Sg]' should have been *nogle* 'some [Plur.PPI]': the context is not negative and there fore the NPI version is no licensed; *sådan* 'such' agrees with its complement in number, e.g. *sådan en hær* 'such an army' or *sådanne hære* 'such armies', or it takes the

If *ingen*, or any of the other variants of the negative quantifier, is the complement of a preposition, it is significantly better to have the *ikke...nogen* version; as (88)a and (89)a show, pied-piping is ungrammatical, and so is stranding, as in (88)b and (89)b (see also section 2.4.4 where I present a cross-linguistic analysis of NEG-shift and prepositions):

(88) *Jeg har [**på** ingen] peget Da: a. т have at no.one pointed b. ??Jeg har ingen peget på Т no.one pointed at have d. Jeg har ikke peget på nogen Т have not pointed at anyone (89) Da: a. *Jeg har [i ingen bøger] læst Ι have in no books read b. ?*Jeg har [ingen bøger] læst **i** books read in Т have no læst **i** [nogen bøger] с. Jeg har ikke Т have not read in any books

I have done a corpus search in two Danish corpora, namely, Korpus90 and Korpus2000 (abbreviated Korpus90/2000 when referring to both), developed by the Danish Language and Literature Society (DSL, <u>http://www.dsl.dk</u>), each consisting of approximately 26 million words (see section 2.2.4 below). I have used the (old version of the) web interface made available from the web page of the VISL project at the Southern Danish University (*Visual Interactive Syntax Learning*, <u>http://visl.sdu.dk/</u>).⁸ A search for *ingen/ingenting/intet* moved across a preposition, i.e. preposition stranding, gave only the following three (or actually four) examples:

quantifier nogle, e.g. sådan nogle hære 'such armies' (literally, 'such some armies'). On Bysoc, see section 2.2.4.

⁸ The present results were obtained via the old interface of VISL, <u>http://corp.hum.sdu.dk/corpustop.da.html</u>, which contained some errors that have been corrected in the new one. However, as I have manually gone through the examples, it should not have any significant influence on the results.

(90) Da: Han ville <u>ingenting</u> tænke på, og de billeder der flakkede He wanted nothing think about and the images that roamed igennem bevidstheden ville han lade forsvinde uden through consciousness-the would he let vanish without at hæfte sig ved dem. to notice SELF at them (Korpus90)

(91) Da: Da sagen var blevet lagt frem her kunne borgmesteren As case-the was been put forward here could mayor-the

> stort set <u>ingenting</u> svare **på**, og det der måske allerede largely seen nothing answer on and that which maybe already

på det tidspunkt kunne have fortalt os at projektet var at that time could have told us that project-the was

dødfødt, nemlig at det var en ledbus, blev heller still-born namely that it was an articulated.bus, was neither

ikke sagt, og det fremgik <u>ingen steder</u> **af**. not said and it appeared no places of (Korpus90)

(92) Da: Han kunne <u>ingen</u> snakke med om sin fortvivlelse, He could no.one talk with about his despair

> og at intet var til at holde ud længere, and that nothing was to to cope out longer

når de lige havde haft en prøve. when they just had had a test "He couldn't talk to anyone about his despair and that he couldn't cope with anything anymore when they had just had a test." (Korpus90)

There are also very few examples of pied-piping, as in the following passive construction. However, I find such examples highly marked: (93) Da: Det kan [af ingen arkivalier] bevises, It can by no records be.proven at jeg har været i Algier på en sådan sendefærd that I have been in Algeria on a such messenger.trip (Korpus2000)

Compare (93) with the *ikke...nogen* version of the passive in (94)a and the active version with *ingen* in (94)b, both of which I find significantly more natural than (93):

 (94) Da: a. Det kan <u>ikke</u> bevises af [<u>nogen</u> arkivalier] at... It can not be.proven by any records
 b. [<u>Ingen</u> arkivalier] kan bevise at...
 No records can prove that

Furthermore, the 'weight' of the negative object plays a role. Just as 'light' pronominal objects undergo object shift (under the appropriate licensing conditions), while 'heavier' full-DP objects never can, NEG-shift is also subject to a 'weight principle': the lighter the object, the better; and the heavier the object gets, the less acceptable NEG-shift gets and *ikke...nogen* becomes obligatory:

(95) Da: a. Jeg har intet hørt have nothing heard Ι Jeg har [intet b. nyt] hørt have nothing new heard Т c. *Jeg har [intet nyt i sagen] hørt Т have nothing new in case-the heard d. *Jeg har [intet nyt i sagen de stjålne malerier] hørt om have nothing new in case-the about the stolen paintings heard Τ Jeg har [intet nyt] hørt [i sagen de stjålne malerier] e. om have nothing new heard in case-the about the stolen paintings Τ f. Jeg har intet hørt [i sagen om de stjålne malerier]

I have nothing heard in case-the about the stolen paintings

65

(96) Da: Jeg har <u>ikke</u> hørt [<u>noget</u> nyt i sagen om de stjålne malerier] I have not heard anything new in case-the about the stolen paintings

The heavy complement of *ingen* and *intet* may be stranded (or indeed right-dislocated) if it is a prepositional phrase, as in (97) below and (95)e-f above, or if it is a clause, as in (98):

(97) Da: "Jeg kan bruge min læreruddannelse, men det kan lige så godt teacher.education but it can just as well Τ can use mγ andet", blive noget helt spår Vilfort og slår be something completely different foretells Vilfort and hits fast at han [ingen ambitioner] **har** [om at blive fast that he ambitions has about to become no fodboldtræner på seniorniveau] (Korpus90) soccer.trainer on senior.level (98) Da: Til sidst kunne han [intet andet] foretage sig To end-the could he nothing else do SELF [end gnide den ophedede våde snudespids i store cirkler wet tip-of-nose in big circles than rub the heated over den kølende nubrede hen muroverflade] (Korpus90) across over the cooling granulated wall.surface

(I return to the weight principle, stranding, and right dislocation in section 2.3). I shall refer to NEG-shifted objects as **complex** if they are 'heavy' in the sense that they have a pied-piped complement, as in (95)b-e above.

2.2.3 Is *ingen* the Result of a Merger between *ikke* and *nogen*?

Kirsti Koch Christensen (1986, 1987) has argued that Norwegian *ingen* should be analyzed as the post-syntactic lexicalization of *ikke* and *nogen*, synchronically as well as diachronically (see chapter 3, section 3.2.5, footnote 58). That is, where *ikke* and *nogen* can be adjacent, they can be substituted with *ingen*.

To test whether it could be argued that Danish *ingen* and *intet* are amalgamations of *ikke nogen* and *ikke noget*, respectively, I have searched Korpus90/2000 for the following three patterns: (a) *ikke nogen* in spec-NegP (NEG-shifted object) or spec-FinP (subject) of a main clause, (b) in spec-NegP (object) of an embedded clause, and (3) topicalized in spec-CP:

(99)	a. FinP / NegP (matrix):	Aux – ikke – nogen/noget
	b. NegP (embedded):	Subj – <i>ikke – nogen/noget</i> – (?) – Aux/Finite verb
	c. Topic:	<i>Ikke – nogen/noget –</i> (?) – Finite verb

(The question mark in brackets (?) stand for 'one or more optional words', here potential NP complements of *ikke* or adverbials.)

None of them gave any results: there were no examples of *ikke nogen* as either topic, subject, or object. In these contexts, *ingen* is obligatory (though I find (100)c somewhat better, but marked and 'childish', than (100)a and b):

(100)	a. Topic / Object:	*[<u>Ikke</u>	nogen	bøger]	har	jeg	læst		
		Not	any	books	have	Ι	read		
	b. Subject:	*[Ikke	nogen	lingvis	ster]	har	læst	den	bog
	2	Not	any	linguis	sts	have	read	that	book
	c. Object:	?*Jeg h	ar [<u>ik]</u>	ke noger	<u>n</u> bøge	er] l	æst		
		I h	ave not	t any	bool	ks r	read		
(101)	a. Topic / Object:	[<u>Ingen</u> bøger] har jeg læst							
		No	books	have 1	I re	ead			
	b. Subject:	[<u>Inge</u> :	<u>n</u> ling	vister]	har	læst	den	bog	
		No	lingu	ists	have	read	l that	book	
	c. Object:	Jeg ha	ır [<u>ing</u>	<u>en</u> bøge	r] læ	st			
		I h	ave no	bool	ks re	ead			

As shown in (102)a and b, the examples in (100)a and b would be grammatical with *en eneste* 'a single' with contrastive focus on *eneste* instead of *nogen*, and the complement NP in the singular, instead of plural (the singular is also compatible with *ingen*). (100)c, on the other

hand, would also be ungrammatical with *en eneste*, cf. (102)c (CAPITALS indicate contrastive focus; the examples could also be constructed with *ikke EN* (*eneste*) with the same acceptability judgments):

(102)	a. Topic / Object:	[<u>Ikke e</u>	n ENESTE	bog] ł	har	jeg	læst		
		Not a	single	book h	have .	Ι	read		
	b. Subject:	[<u>Ikke e</u>	n ENESTE	lingvi	ist]]	har	læst	den	bog
		Not a	single	lingui	ist 1	has	read	that	book
	c. Object:	*Jeg har	[ikke en	n ENESI	r <u>e</u> bo	g] 1	læst		
	-	I hav	e not a	singl	le bo	ok 1	read		

There is also a number of expressions with *ingen/intet* as part of an adverbial phrase that can not be constructed with *ikke nogen/noget* inside the prepositional phrase (the contrasts in (103)-(105) are parallel in English)

(103)	Da:	a.	Jeg	har	[på	inge	<u>n</u> måd	e]		sagt	at	det	var	i	order	ſ
			I	have	e in	no	way			said	that	it	was	in	ordei	r
		b.	*Jeg I	har <i>have</i>	[på e <i>in</i>	<u>ikke</u> not	noge any	<u>n</u> må waj	de] Y	sagt <i>said</i>	at that	det it	var was	i in	orden orden	n r
(104)	Da:	a.	Jeg I	har <i>have</i>	[på • <i>on</i>	<u>inte</u> no	<u>t</u> tid <i>poi</i>	spun nt.o	kt] £.ti	ime	s <i>s</i>	agt <i>aid</i>	at that	det it	var was	okay <i>okay</i>
		b.	*Jeg I	har <i>have</i>	[på • <i>on</i>	<u>ikke</u> not	noge any	<u>t</u> tio po	dspı int.	unkt] . <i>of.t</i> :	s ime s	agt aid	at <i>that</i>	det it	var was	okay <i>okay</i>
(105)	Da:	a.	Jeg I	kan <i>can</i>	[und und	der <u>i</u> der no	ngen o cir	omsta cums	endi t <i>an</i> c	ghede ces	er]		accer <i>accer</i>	oter ot	re det det	5
		b.	*Jeg I	kan <i>can</i>	[und und	der <u>i</u> der no	kke n ot a	ogen ny	oms cii	stændi rcumst	ighed <i>ance</i>	er] s	accer accer	pter pt	re det det	

(106)	Da:	a.	Jeg	har	[inger	<u>n</u> stede	er]	været
			Ι	have	no	place	9 <i>5</i>	been
		b.	*Jeg	har	[<u>ikke</u>	nogen	steder]	været
			I	have	not	any	places	been

The conclusion is that *ingen* is not, or at least does not have to be, the result of a synchronic post-syntactic amalgamation og *ikke* and *nogen*.

In the next section I present results from the two corpora of written texts, Korpus90/2000, and one of spoken language, BySoc, showing the relative use of *ingen* versus *ikke nogen* in written and spoken language, and that *ingen* appears to be in the way out.

2.2.4 Comparing Corpora: Variation and Change

The sources for the three corpora are not identical. However, Korpus90 and Korpus2000 are similar in size and composition which makes it possible to compare the two directly. Korpus90 consists of written texts from the period 1988-1992, and Korpus2000 consists of written texts primarily from 1998-2000 – both sampled from a wide variety of newspapers, magazines, books, etc.⁹ In contrast, the third corpus, BySoc,¹⁰ is a corpus of spoken language collected around 1987 and consists of app. 1.454 million words. The source is 80 informal conversations between speakers of Copenhagen Danish. That is, unlike Korpus90/2000, BySoc covers only a single dialect or sociolect which should be kept in mind when comparing it to the other corpora.

The following search patterns were used for the search in al three corpora:

Main clause: Aux – *ingen/intet/ingenting* – Perf. Pcp. / Infinitive
 Embedded clause: Subject – *ingen/intet/ingenting* – Aux / Perf. Pcp. / Infinitive

In order to compare the number of occurrences of *ingen* with that of *ikke...nogen*, the following search patterns were used:

(108) Main clause: Aux - (?) - ikke - (?) - Perf. Pcp. / Infinitive - nogen/nogetEmbedded clause: Subject - ikke - (?) - Aux / finite Verb - nogen/noget

 ⁹ Cf. the webpage of the *Danish Language and Literature Society* DSL, <u>http://korpus.dsl.dk</u>.
 ¹⁰ BySoc is short for *Projekt Bysociolingvistik* 'project city-sociolinguistics', <u>http://www.id.cbs.dk/~pjuel/cgi-bin/BySoc_ID/index.cgi</u>.

First I present the data related to the frequency of NEG-shift before turning to complexity of the shifting objects and the weight principle.

The following table is a summary of the frequency of NEG-shift in relation to the total number of negative transitive main and embedded clauses with an auxiliary and an indefinite object. The values are given in ratios (number of NegQPs, i.e. *ingen/intet/ingenting* to the number of *ikke...nogen/noget*) and percentages (for example: 178: 826 means 178 examples with *ingen/intet/ingenting* to 826 examples with *ikke...nogen/noget*, or 17.73% *ingen/intet/ingenting* in all the negative sentences with an indefinite object.):

(109)	NegQP: Neg+QP ratios
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	Main clauses	Embedded clauses	Total
Korpus90	178: 826 = 17.7%	491: 1191 = 29.2%	669: 2699 = 24.8%
Korpus2000	142: 767 = 15.6%	384: 1179 = 24.6%	526: 2482 = 21.2%
BySoc	6: 311 = 1.9%	13: 102 = 11.3%	19: 413 = 4.4%

It is interesting to note that *ingen/intet/ingenting* is more frequent in embedded clauses than in main clauses in all three corpora:





As mentioned in section 2.2.2, some speakers find NEG-shift more formal than *ikke...nogen*. If it is assumed that NEG-shift is somewhat formal, literary, or archaic, then the graph shows that Korpus2000 is less formal than Korpus90 and, not surprisingly, that BySoc is

significantly less formal than Korpus90/2000. Nonetheless, NEG-shifted objects still occur in spoken Danish, though to a lesser extent than in the written language.

The percentages for the BySoc corpus seem very small compared to the ones for Korpus90/2000. This could be taken to suggest that the use of *ingen* has dropped drastically. On closer inspection, however, it appears that it is not so straight forward. To compensate for the fact that BySoc is very much smaller than the other two (it contains 1.454 million words), the values for BySoc can be multiplied by the factor of 17.8817 such that all three corpora consist of app. 26 million words (for example, main clause *ikke...nogen*: 5561 adjusted = 311 actual * 17.8817):

	Main	clauses	Embedded clauses			
	Ingen	Ikkenogen	Ingen	Ikkenogen		
Korpus90	178	826	491	1191		
Korpus2000	142	767	384	1179		
BySoc (adjusted)	107	5561	233	1824		

(111) Number of *ingen/intet/ingenitng* and *ikke...nogen/noget*

The striking result is that there are 5561 examples of *ikke...nogen* in main clauses and 1824 in embedded clauses which are significantly more than in Korpus90/2000. The number of *ingen/intet/ingenting* appears to follow the general decreasing slope:

(112)



For some reason, it appears that negative clauses are significantly more frequent in spoken language than in written language, especially in main clauses, while there are significantly fewer examples with NEG-shifted objects, especially in embedded clauses.

Turning next to the notion of complexity in the sense that a NEG-shifted object consists of the negative quantifier plus one or more words; the NegQP has a pied-piped complement). In the table in (113) below, there are to two entries for BySoc, one with the actual numbers and one adjusted for size:

		Main clau	uses	Em	bedded cla	Total	
	Ingen	Intet	Ingenting	Ingen	Intet	Ingenting	
Korpus90	46/53	8/108	17	157/170	14/272	49	225/669=33.6%
Korpus2000	40/43	4/87	12	138/143	18/229	12	200/526=38.0%
BySoc	0/0	0/6	0	11/12	0/0	1	11/19=57.9%
BySoc	0/0	0/107	0	197/215	0/0	18	197/340=57.9%
(adjusted)							

(113) Complex NegQPs: Number of *ingen*, *intet*, and *ingenting* (complex/total)

Given that there would probably be examples of *ingen* and *ingenting* in main clauses and *intet* in embedded clauses if BySoc actually were based on 26 million words, the zeros in the table would disappear. (Due to these zeroes or holes in the paradigm, comparisons with BySoc are bound to be a bit uncertain.) The number of *ingen/intet/ingenting* would probably not be smaller than in Korpus90/2000, more likely greater: Note that the frequency of *ingen/intet* (not *ingenting*) in embedded clauses in BySoc is greater than in Korpus90/2000. In other words, if one compares the number of complex NEG-shifted objects in embedded clauses (there are no such examples with main clauses in BySoc) in proportion to the total number of embedded clauses with NEG-shift (*ingen/intet/ingenting*), it actually appears that there is an increase in frequency:

(114) Complex NegQP in embedded clauses with NEG-shift


Korpus90	Korpus2000	BySoc (adjusted)
Complex (157 ingen + 14	Complex (138 ingen + 18	Complex (197 ingen) / Total
intet) / Total (170 ingen +	intet) / Total (143 ingen +	(215 ingen + 18 ingenting)
272 intet + 49 ingenting)	229 intet + 12 ingenting)	
171/491 = 34.4%	156/384 = 40.6%	197/233 = 84.6%

(115) Complex NegQP in embedded clauses with NEG-shift

Let us return to the weight principle discussed in section 2.2.2 above. Recall that NEGshift becomes less acceptable when the 'weight' or length of the object increases. The table below shows the weight principle at work (values are calculated as number of examples with 1/2/3 words per total number of examples with NEG-shift):

(116) Number of words in NEG-shifted NegQP

Words	Korpus 90	Korpus 2000	BySoc	BySoc (adjusted)
1	444/669 = 66.4%	326/526 = 62.0%	8/19 = 42.1%	143/340 = 42.1%
2	214/669 = 32.0%	190/526 = 36.1%	11/19 = 57.9%	197/340 = 57.9%
3	11/669 = 1.6%	10/526 = 1.9%	0	0

Those with three words are of the NegQ-Adj-Noun type, such as:

(117)har [ingen offentlig debat] været, og Novo har opnået Da: Der There has public debate been and Novo has attained no en statslig accept af et indhold på op til 400 bakterier a stately accept of a content on up to 400 bacteria pr. gram produkt. (Korpus90) per gram product (118)Da: "Vi har fortsat [ingen officiel meddelelse] modtaget fra de We have still official message received from the no

> iranske myndigheder", fastslog Udenrigsministeriet i går Iranian authorities maintained foreign.minister yesterday

inden mødet i Holland before meeting.the in Holland (Korpus2000)

2.2.5 Summary and Conclusions

The distribution of *ingen* (and *intet*) and *ikke nogen* (and *noget*) shows that *ingen* can not be (or at least does not have to be) a 'post-syntactic lexicalization' or merger of *ikke* and *nogen*, as Kirsti Koch Christensen (1986, 1987) has argued for Norwegian.

NEG-shift of *ingen/intet/ingenting* is still used in written texts quite often. 15.5% of negative transitive main clauses with an indefinite object and 24.6% of the clauses have NEG-shift. The frequency, however, appears to be decreasing. In section 2.3.8, I argue that OV word order is lost in stages such that movement targeting positions low in the structure is lost before movement targeting higher positions. Danish has already lost VP-internal scrambling and overt quantifier raising, and the last OV remnant, namely, NEG-shift, seems to be next in line.

There are significantly fewer examples of NEG-shift in the spoken language, judging from the comparison of the present three corpora. Nonetheless, NEG-shift is still used in spoken Danish and is not reserved for formal writing. It should also be kept in mind that BySoc is a sample of speakers from Copenhagen, not from a representative set of speakers of Danish, and there may (or, indeed, may not) be dialectal differences.

In all three corpora, NEG-shift is much more frequent in embedded clauses than in main clauses. At present, I have no explanation for this

The weight principle, to which I return in section 2.3 on quantifier raising and rightdislocation, constrains the applicability of NEG-shift. However, it is interesting to note that it only sets in after two words.

There are significantly more negative sentences, primarily of the *ikke...nogen* type, in the data from spoken language than in Korpus90/2000. There are 3.7 as many examples of *ikke...nogen* in BySoc as in the average of Korpus90/2000 (3 times as many if *ingen/intet/ingenting* is included in the comparison). I have no explanation for this other than it may be due to the settings and elicitations of the conversations, and perhaps also the subject of conversation.

In section 2.4, I present a comparative syntactic analysis of NEG-shift phenomena in Danish and the other Scandinavian languages (Faroese, Icelandic, Norwegian, and Swedish), English, Finland Swedish, French, and Polish (only touching on Finnish, Hebrew).

2.3 Quantifier Movement and Derivation by Phase

2.3.1 Introduction

In this section, I shall first briefly discuss NEG-shift and other types of object movement and argue that each type of movement targets its own specifier in the clausal spine. Then I discuss quantifier raising (QR) which applies overtly in some languages, and as QR cannot be subsumed under any of the other types of object movement, I shall argue that it targets a specifier of its own. Next I argue that when NEG-shift, which is otherwise obligatory in order to license sentential negation, does not apply, the negative quantifier phrase (NegQP) can be interpreted as an instance of zero-quantification. After a brief introduction to the framework of derivation by phase, which explicitly dispenses with covert movement in favour of long-distance agreement, I shall argue that covert movement should be allowed to apply to operators in order to account for the scope ambiguities in cases where overt NEG-shift and/or QR is blocked. This leads to an outline of a typology of quantifier movement. I shall also argue for a revision of the base-position of negative adverbials.

Before turning to some remaining issues such as QR and locality effects, and NEGshift, presupposition, and clause-boundedness, I shall digress somewhat and discuss how NegQPs are treated in a version of functional grammar.

2.3.2 NEG-shift

All the Scandinavian languages have what I call NEG-shift – the overt movement of indefinite quantified negative objects to a pre-verbal position (see sections 2.2.2 and 2.3.2 above). The target of this movement is generally assumed to be spec-NegP and it is obligatory in order to license sentential negation (Christensen 1986, 1987, Haegeman 1995, Haegeman & Zanuttini 1991, Jónsson 1996, Kayne 1998, Platzack 1998, Rögnvaldsson 1987, Sells 2000, Svenonius 2002). The negative polarity is evident from the acceptability of the negative tag:

```
(119) Da: a. *Jeg har faktisk [NegP [vP set ingenting1 ]]...
b. Jeg har faktisk [NegP ingenting1 [vP set t1 ]]...
I have actually nothing seen
...og det har du heller ikke
...and that have you neither not
"I haven't actually seen anything and neither have you."
```

In modern spoken Norwegian NEG-shift is only possible in the string-vacuous version where the main verb is V2 position; it never applies across the main verb (Svenonius 2002). It is, however, still possible is written Norwegian. The same tendency appears to be present in Danish as well, though nowhere near as drastic as in Norwegian (section 2.2.4). It seems as if this last remnant of OV word order is on its way out (see section 2.3.8).

Note that the target position follows sentential adverbials, which are adjoined to NegP.¹¹ NEG-shift is not subject to *Holmberg's Generalization* (HG, Holmberg 1986: 165, 1999: 2):

(120) Object shift cannot move across the surface position of its case assigner and is therefore dependent on verb movement.

(Arguably, NEG-shift is subject to HG in English as it is Norwegian and colloquial Danish. I return to Holmberg's Generalization and NEG-shift in section 2.4.7 below.)

2.3.3 Object Movement

Other types of object movement, such as Topicalization, *wh*-movement, and raising-to-subject in passivization, may also violate Holmberg's Generalization. Object shift, on the other hand, is the movement on which HG is based (I leave out irrelevant traces):

(topicalization) (121)Da: a. Den film₁ har jeg faktisk ikke [$_{vP}$ set t₁] That movie have I actually not seen (*wh*-question) b. $Hvad_1$ har du ikke [vP set t_1]? What have you not seen (passive) $t_1 \mbox{ ikke } [_{vP} \mbox{ set } t_1 \mbox{] af mange }$ c. Filmen₁ blev The movie became not of many seen "The movie wasn't seen by many:" (122)(object shift) Da: a. *Jeg har den₁ faktisk ikke [$_{vP}$ set t₁] Ι have it actually not seen

¹¹ The ordering of the adverbials is determined by semantics and scope relations (e.g. Nilsen, to appear). Alternatively, one could assume that an array of functional projections housing sentential adverbials of different semantic types and scope dominates NegP (cf. Cinque 1999). The important thing is that negation follows all sentential adverbials.

Note that the target of object shift is a position above sentential adverbs, i.e. above NegP but below the subject position, spec-FinP. Platzack (1998: 137), Müller (2001: 289) and others have argued that the target of pronominal object shift (and scrambling of pronouns) is the specifier of a separate functional projection (see section 2.5 below).^{12, 13} This is illustrated in (123) below.



¹² As I argue below, in a probe-goal account, XP movement is only licensed in the presence of an EPP feature. Hence, XP movement always targets a specifier position and is never movement to adjunction.

¹³ This projection, $\pi P/\mu P$, is positioned higher than the projection sometimes posited for object agreement, AgrOP, which is normally projected between TP and *v*P/VP (see also footnote 21).

¹⁴ When the object is an indefinite quantifier, the subject cannot be a universal quantifier too, and quantifier floating does not co-occur with NEG-shift, see section 2.3.13.1 below.

It is clear that NEG-shift does not fall under any of the movements in (121) and (122). Apart from syntactic distribution, note also that unlike pronominal object shift, NEG-shift is independent of prosody (stress), and unlike Icelandic full-DP object shift, NEG-shift is not dependent on definiteness as negative quantifiers are inherently indefinite.¹⁵

2.3.4 Quantifier Movement

In Icelandic, but not in any of the other Scandinavian languages, other quantified objects may optionally also move across the verb. I follow Svenonius (2000*b*) and take this movement to be overt Quantifier Raising (QR). Depending on the specific quantifier, QR is acceptable with varying degrees of acceptability (see Rögnvaldsson 1987, Svenonius 2000*b*):

(124)Da: a. [vp fået Jeg har mange]] [vP fået]] b. *Jeg har [mange1 t1 Ι received have many (125)Ic: a. Jón hefur $[_{vP}$ þurft að þola ýmislegt]] b. Jón hefur [ýmislegt1 [vp burft að þola 11 t1 John has various had to tolerate (Rögnvaldsson 1987, (25)) (126)Ic: a. Hún hefur ekki [vp lesið margar af bókunum] b. ?Hún hefur ekki [margar₁ [_{vP} lesið t₁ af bókunum]] c. *Hún hefur margar₁ ekki [vP lesið t1 af bókunum] She has read of books-the many not "She hasn't read many books." (Hrafnbjargarson, p.c.)

Note that this is not object shift, because the moved object follows negation (cf. the ungrammaticality of (126)c), and it cannot be NEG-shift, because negation is already licensed by *ekki* in spec-NegP and the quantifier is not (necessarily) negative. Rögnvaldsson (1987) and Svenonius (2000*b*) assume this position to be adjoined to the highest VP, that is, to the empty projection of the moved finite auxiliary or main verb.

¹⁵ Rizzi (1997) argues that FinP is part of an articulated CP-domain, whereas I take it to be the topmost projection in the IP-domain. The difference is not crucial here. What is important is that there is a projection to house the subject between C^o (the V2 position) and NegP and the sentential adverbials adjoined to it. As finiteness typically licenses nominative subjects, and as agreement projections (AgrSP and AgrOP) are otherwise unnecessary and therefore, by economy, non-existent (Chomsky 1995), I find it natural to assume this projection to be FinP.

Interestingly, the movement pattern for negative and quantified objects (i.e. overt QR) is not a feature specific to the Germanic languages. In French, "strong" quantifiers move across the verb. For example, quantifiers such as *rien* 'nothing', *tout* 'all', and *beaucoup* 'much/many' (cf. Confais 1978: 137, §231; 235, §417b; Pedersen et al. 1996: 93), but not *aucun* 'no' and *personne* 'no one', move to a position preceding the VP-domain – *rien* obligatorily, the others optionally.¹⁶

(127)Fr. a. Je n'en ai [vP trouvé aucun] b. *Je n'en ai $[aucun_1 [_{vP} trouvé t_1]]$ 11 I NEG-of.them have none found "I haven't found any." (cf. Confais 1978: 135) (128)Fr: a. Je n'ai [_{vP} vu personne] b. *Je n'ai [personne₁ [_{vP} vu]] t_1 I NEG-have nobody seen "I haven't seen anybody." (cf. Confais 1978: 135) (129)Fr: a. *Pierre n'a [vP mangé rien] b. Pierre n'a [rien₁ $[v_{P} mangé t_1]$]] Pierre NEG-has nothing eaten "Pierre didn't eat anything." (cf. Nølke 1997: 234) (130)Fr: a. J'ai [vp vu tout] b. J'ai [tout₁ [$_{vP}$ vu t₁ 11 I-have all seen "I have seen everything" (Haegeman 1995: 231, (87)) (131)Fr: a. Il a [vP consulté beaucoup de livres] b. Il a [beaucoup₁ [$_{vP}$ consulté t₁ de livres]] of books He has many consulted "He consulted many books." (Rizzi 1990: 12, (27))

In Polish, according to Dornisch (2000), negative objects must move to a preverbal position (i.e. obligatory NEG-shift) and the same goes for non-negative quantifiers (i.e. QR;

¹⁶ According to Haegeman (1995: 231) Genevan French, unlike standard French, also allows *personne* to move across the verb.

(132)a and (133)a are acceptable with "heavy focal stress" on the object). To some speakers, these movements are optional, hence the % marks:¹⁷

(132) $[NegP [Neg^{\circ} nie widziała_v] [vP t_v nikogo]]$ Po: a. %Anna Anna <u>nikogo</u>₁ [$_{NegP}$ [$_{Neg^{\circ}}$ nie widziała_v] [$_{vP}$ t_v t₁]] b. Anna nobodv NEG saw "Anna didn't see anybody" (Dornisch 2000: 52, (8)) [_{TP} widziała_v [_{vP} t_v coś]] (133)Po: a. %Anna $[_{TP} widziała_v [_{vP} t_v t_1]]$ b. Anna coś₁ Anna someone saw "Anna saw someone" (Dornisch 2000: 52, (9))

This shows that some quantifiers undergo overt QR to some pre-verbal position, say, αP , in French, Icelandic, and Polish (and in many other languages, such as Hungarian¹⁸). (I leave out the target projection for object shift throughout.)

Clearly, the target for QR in Hungarian is not the same as the position I propose, namely, spec-vP: the former precedes negation, the latter follows it. However, assuming derivation by phase, in order to leave the vP phase the object must move through spec-vP; the important difference is that it can not stay there in Hungarian.

¹⁷ According to Piotr Garbacz (personal communication), NEG-shift and QR are optional in Polish. Furthermore, both simplex and complex NegQPs may optionally undergo NEG-shift or QR; i.e., NEG-shift and QR do not seem to be subject to a weight principle as, for example, NEG-shift is Danish. Interestingly, to anticipate the discussion in section 2.3.5, negative quantified objects are ambiguous in situ as well as in the shifted position; NegQPs can be interpreted as either licensing sentential negation or as instances of zero-quantification in both positions. (In addition, even non-quantified objects may move to a preverbal position if they have contrastive focus and emphatic stress; this appears to be focalization or, possibly, scrambling.)

¹⁸ Olsvay (in press) has, independently, proposed an analysis of Hungarian quantifiers very similar to the one proposed here. According to Olsvay, negative quantifiers optionally move to spec-NegP overtly, immediately preceding the proclitic Neg^o *nem* 'not' to which the verb adjoins. Subsequently, NegQPs undergo obligatory overt QR to spec-QP above NegP (between the recursive projections for topic and focus: TopP and F(oc)P, which is also the target for optional QR of positive objects. NegQPs, according to Olsvay who adopts the syntactic approach proposed by Chomsky (1995), have an optional [+q] feature, which, when present, must be checked against a strong [+q] feature on Q^o. On the other hand they also have a [+neg] feature which must be checked against a weak [+neg] on Neg^o; assuming Procrastinate, this takes place after Spell-Out. In other words, QR of both negative and non-negative quantifiers is optional, and NEG-shift only applies overtly when the object subsequently undergoes QR. Otherwise, NEG-shift applies covertly.

A possible analysis is to assume that in Hungarian, as in the other languages analyzed here, the probing [uQuant] feature is on Fin^o. In Germanic, spec-Fin^o is used to satisfy the subject requirement (the Extended Projection Principle (EPP) or the Nexus relation). In Hungarian, spec-FinP is not needed for EPP (which is established below NegP, presumably in spec-TP), and it is therefore available for further overt QR which accounts for the high position of Hungarian quantifiers relative to, say, Icelandic ones. Assuming multiple specifiers at the phase edge, CP may have specifiers for topic and focus, as many as required, allowing a NEG-shift object to be focalized or topicalized if required for scope reasons.



Below I argue that this αP is in fact neither a separate projection nor an adjoined position; rather, the target of QR is the topmost specifier of vP.

2.3.5 Zero-quantification

As mentioned above, NEG-shift in Scandinavian is obligatory in order to license sentential negation. French *rien*, on the other hand, is ambiguous in the shifted position (QR of *rien* is obligatory) between sentential negation (wide scope), *rien*_{neg}, and zero-quantification (narrow scope, 'trifling' negation (Svenonius 2002)), *rien*_{zero} (Eric Mathieu, p.c.)¹⁹. (If *rien*_{zero} is the complement of a preposition, movement is blocked, see section 2.4.4.5. below)

Imagine a contest of some sort, for example the Eurovision song contest (as in the examples in Svenonius 2002), where contesters are evaluated and rewarded with an amount of points from zero to, say, ten.

- (135) Fr: Je n'ai $\underline{rien_1}$ [_{vP} reçu t₁] I NEG-have nothing received
 - i. Zero-quantification: "I scored zero points"
 - ii. Sentential negation: "I haven't got any points yet/I hasn't been judged yet"

¹⁹ Interestingly, there is variation in the interpretation of French *rien*. According to Christopher Laenzlinger (p.c.), both *rien* and *aucun* can only mean zero-quantification, whereas the 'not any' version, *je n'ai pas reçu de points* 'I have not received any points' (literally: I NEG-have not received of points), is potentially ambiguous between sentential negation and zero-quantification. Thus, in this variant, *rien* obligatorily moves to spec-*v*P (α P), but never to spec-NegP.

Retaining the idea that different scope interpretations derive from different structural positions, cf. Aoun & Li's (1989: 141) *Scope Principle* (α scopes over β if α c-commands a member of the chain containing β) and Diesing (1997) *Mapping Hypothesis* (syntactic domains map into relative scope relations, see section 2.4.5 below), this difference in interpretation (zero-quantification vs. sentential negation) suggests that there are two different positions (the difference between which, however, is string-vacuous), which also fits the distinction between NEG-shift and QR mentioned above: movement to spec-NegP in the former case, and movement to spec- α P in the latter.

(136)	Fr: a.	$[rien_1$	$[vP Verb t_1]$	(Zero-quantification)
	b. [$_{NegP}$ rien $_1$ Ne	eg° [t ₁	[vP Verb t1]]]	(Sentential negation)

Icelandic enginn, may optionally undergo QR:

(137) Ic: a. Ég hef $[v_P fengið engin stig]$ I have received no points

- i. Zero-quantification: "I scored zero points"
- ii. *Sentential negation: "I haven't got any points yet/I haven't been judged yet"

b. Ég hef <u>engin stig1</u> [vp fengið t1]]
I have no points received

- i. Zero-quantification: "I scored zero points"
- ii. Sentential negation: "I haven't got any points yet/I haven't been judged yet"



In Danish, as well as in the other Scandinavian languages, only the sentential negation reading is possible with a shifted *ingen* object:

ii. Sentential negation: "I haven't got any points yet/I haven't been judged yet"

haven't been judged yet"

In other words, as QR is not an option, *ingen* only moves if NEG-shift applies.²⁰



English *no* (*-thing/one/-body/-where*), like French *aucun* 'nothing', does not move and is ambiguous in situ (neither NEG-shift nor QR applies).

²⁰ Some Danish speakers get the same ambiguity reading as the Icelandic one in (137)b.

- (142) En: She has received <u>no points</u>
 - i. Zero-quantification: "She scored zero points"
 - ii. Sentential negation: "She hasn't got any points yet/She hasn't been judged yet"

The same applies to Finland Swedish (at least in clauses with an auxiliary), cf. Bergroth (1917: 172-175). In Finland Swedish, unlike standard Swedish and the other Scandinavian languages, *ingen* follows the non-finite main verb.

(143)FS: a. Han hade $[v_{P}$ haft ingen aning om hela saken] b. *Han hade ingen aning1 $[v_{P} haft t_{1}]$ hela saken] om knowledge had He had no about whole case.the "He hadn't known anything about the entire matter." (Bergroth 1917: 173)



In German, *kein* is also potentially ambiguous but the positions are hard to pinpoint because of German OV word order and scrambling:

It should be noted that zero-quantification presupposes the existence of the quantified object, while that is not so with negative quantifiers with sentential scope (see also section 2.3.13.2 below), which explains why zero-quantification is only possible with **scalar** properties such as points, money, and weight, but not non-scalar entities like cars, houses, and people:

```
(146) a. *I talked to zero people on my way home from work yesterday.b. *I just bought zero cars.
```

It also explains why the following example is normally unambiguous:

(147) Eating nothing will lead to certain death

2.3.6 Derivation by Phase

According to Chomsky's (1995) *Minimalist Program*, QR is movement of a [quant] feature to "an appropriate host", either T^o or v^{o} . Furthermore, covert (LF) movement (e.g. Chinese and Japanese *wh*-movement and QR in general, assumed to be adjunction to T) is restricted to X^o movement of formal features.



In this framework elements move to have some uninterpretable feature checked, that is, the moved element gets a feature checked, not the target.

In *Derivation by Phase* (Chomsky 2001; see also Radford 2004, chapter 10), on the other hand, Chomsky dispenses with covert LF movement altogether and replaces it with long-distance probe-goal agreement. Below I adopt this approach and introduce a slight modification.²¹

²¹ In fact, the analysis argued for below could also be argued for assuming an AgrOP projection headed by AgrO^o_[uQuant] immediately above vP; that would avoid multiple specifiers at the cost of postulating agreement

The derivation or structure building process proceeds in phases. The input for the derivation, the numeration or lexical array, is divided into sub-arrays which in turn are inputs for sub-derivations. CP, the discourse level (illocutionary force), and *v*P, the level of predication (argument structure, the "who did what to whom"), are strong phases. Once a phase is completed, the (c-command) *domain* is sent to PF encoding and is therefore not accessible for further syntactic computation. (In this model there are multiple Spell-Outs.) The *periphery* (specifier and phase X°) is available as part of another sub-array providing input to the derivation of another phase. The process continues until the (super-) array is emptied. The following illustration shows the derivation of a two-phase structure (the significance of the two-way arrows will become apparent):



As opposed to the framework outlined in Chomsky (1995), derivation by phase is driven by uninterpretable features on the target, the *probe*, not the moving element, *the goal*. Furthermore, XP movement is only possible if there is a specifier to act as target, i.e. the probing head must have an EPP-feature which licenses a spec-position (downward right-angled arrows indicate probing, upward curved dotted arrows indicate movement):

projections, cf. e.g. van der Wurff (1999). Chomsky (1995: 352) explicitly abandons AgrOP in favour of a vP with multiple specs.



 Z° has an unvalued feature [uF] which makes it a *probe*. It searches down its (c-command) domain for a matching feature [+/-F] for valuation (and deletion), i.e. for a *goal*, and finds an XP with [+F]. Z° 's [uF] is valued and deleted, and as Z° also has a spec-licensing EPP-feature, it *attracts* XP which is then moved to Spec-ZP. Without the EPP-feature, Z° and XP would enter into *long-distance agreement* without movement.

The *Phase Impenetrability Condition* (Chomsky 2001: 14, (11); see also Radford 2004: 382, (1); the latter is cited as in (21) in chapter 0, section 1.2.5) states that only elements at the *periphery* (adjuncts, specs and the phase head) of a strong phase (CP and transitive vP) are available for operations (Attract/Move or Agree) outside the phase:

(151) The Phase Impenetrability Condition (PIC)

- a. The (c-command) domain of a phase head is inaccessible to operations outside the phase; only the phase edge is accessible.
- b. The edge of a phase consists of specifiers, adjuncts, and the phase head itself.
- c. CP and v^*P (transitive vP) are strong phases.

Together, the PIC and the EPP requirement on XP movement necessitate that phase heads can have multiple specifiers. In short, the outer spec-vP (the inner one is the base-position of the (agent) subject) is the 'escape hatch' for XP movement out of vP – the "VP-domain":



In fact, I assume a stronger version of derivation by phase than Chomsky (2001). In the present account only the edge is accessible to probes outside the phase, whereas in Chomsky (2001: 14) probes in TP are allowed to search inside vP; only at the next phase level, CP, does VP become impenetrable.

2.3.7 Covert Movement and Feature Checking

2.3.7.1 The Target of QR

Unvalued (uninterpretable) features must be checked before PF and LF (where they would have no interpretation) or the derivation crashes. Thus, to make elements within the domain of v° accessible to probes outside *v*P, such elements must move to he edge of *v*P.

An EPP-feature is inserted on v° as Last Resort to secure convergence. Hence, quantifiers must move to vP before T^{\circ} is merged. Assuming multiple specifiers, NEG-shifting objects and quantifiers undergoing (optional or obligatory) overt QR move to what must be a specifier above the one hosting the subject, i.e. the outer specifier of vP:



That this position is a specifier and not an adjoined position also follows from the fact that attraction / movement is only induced if the probe has an EPP-feature licensing a spec position. Adjunction is therefore limited to Merge ("base-generation"). (This has serious consequences for the analysis of negative adverbials. I return to this in 2.3.11 below.)

What about the fact that quantifiers that do not move are ambiguous between wide and narrow scope, as e.g. some French and Icelandic quantifiers and all the English ones? I propose both a *revival* and a *revision* of covert movement such that overt QR is pied-piping of the phonological features and covert QR is stranding the phonological features.

2.3.7.2 Reviving Covert Movement

What I propose is a *revival* (I shall get back to the *revision* part) because it is contrary to Chomsky (2001) who explicitly states that it is the highest element of a chain that is spelled out (in later papers he has indeed reintroduced covert movement. I shall return to this shortly). However, covert movement is not entirely abandoned because his rule for 'heavy-NP shift',

TH/EX (*Thematization/Extraction*, Chomsky 2001: 20), is exactly such a rule that strips the PF features and leaves the covert formal feature bundle available for narrow syntax. For example, a heavy extraposed ("right-dislocated") subject leaves a phonetically 'empty' subject (Subj_{LF}) that checks EPP on T^o covertly. The right-dislocated subject consists only of phonological features (Subj_{PF}) and is not available for further operations in the narrow syntax.



This leaves open the question of how this is licensed in the syntax. As argued in the previous section, XP movement is otherwise crucially dependent on EPP-features licensing target specifiers. It could be the case that TH/EX is also dependent on the phonological stranding operation I propose in the next section, such that the right-dislocation itself is a PF operation. However, I disregard the problem here.

The heavy part of a quantified object may also be subject to TH/EX (cf. also that in Old English, positive quantified objects could be extraposed while positive non-quantified and negative objects could not, cf. Pintzuk 2004; I return to Old English below). This accounts for the different degrees of acceptability in the following Danish examples showing a correlation between decreasing acceptability and increasing 'heaviness' (the same principle holds for Swedish, Elisabet Engdahl, p.c.):

(156)Da: Jeg har [$_{NegP}$ ____1 [$_{vP}$ fået t₁]] Ι have received ingen a. none b. ingen bøger no books c. ??ingen tykke bøger no thick books d. *ingen tykke bøger om generativ lingvistik thick books about generative linguistics no *ingen tykke bøger der handler om lingvistik e. thick books which deal with linguistics no

In Danish, TH/EX may apply to the 'heavy' PP part of the object (like French *beaucoup*, cf. (131) above) and (marginally) to the embedded CP, but not to the NP complement, while the negative quantifier *ingen* undergoes obligatory NEG-shift (pied-piping its NP complement):

```
(157)
        Da: a. *Jeg har [_{NegP} [ingen t_{NP}]_1 [[_{vP} fået
                                                                t1]
                  Ι
                       have
                                  no
                                                     received
                                      [NP bøger om
                                                        generativ lingvistik]]]
                                         books about generative linguistics
             b. Jeg har [_{NegP} [ingen bøger t_{PP}]<sub>1</sub> [[<sub>vP</sub> fået
                                                                       t1]
                    Ι
                       have
                                            books
                                                              received
                                     no
                                                generativ lingvistik]]]
                                     [PP OM
                                                 about generative linguistics
             c. ?Jeg har [_{NeqP} [ingen bøger t_{CP}]_1 [[_{vP} fået
                                                                       t_1]
                       have
                                         books
                  Ι
                                  no
                                                            received
                                     [_{CP} der
                                                handler om
                                                               lingvistik]]]
                                                      with linguistics
                                      which deals
```

The same is true for Icelandic QR (Rögnvaldsson 1987, Svenonius 2000*b*, (14a-e)). Acceptability decreases as the objects gets longer/heavier. As (159) below and (126)b above show, PPs and CPs may be subject to TH/EX (judgments due to Hrafnbjargarson, p.c.):



I assume QR (overt or covert) to be driven by an uninterpretable / unvalued (wide scope) quantifier feature [uQuant] on Fin^o (in accordance with the standard GB analysis of QR as adjunction to IP; however, [uQuant] may also be inserted on C^o if scope relations require so) and EPP on v^o inserted as Last Resort enabling the object to escape vP. In this way, QR reduces to long-distance agreement (for reasons of space I leave out NegP and TP; t_{Subj} is the trace of the subject which has moved to spec-TP):



Movement to spec-vP is just the 'escape hatch', which is also required in e.g. wh-questions and topicalization of non-quantified elements such as adverbials and PPs. For the same reason, I do not adopt Svenonius' (2000*a*: 5, footnote 5) term *Case Shift* (adverbials and PPs do not have case) nor Chomsky's (2001) *Object Shift*, which (as argued in section 2.3.3 above) is normally reserved for the object movement to a position above negation (which corresponds to Chomsky's (2001: 30 and footnote 63) object shift + DISL (*Dislocation*), as also noted by Svenonius 2002).

Placing [uQuant] on Fin^o also captures the fact that QR is (usually) strictly clause bound (but see section 2.3.13.3 for some exceptions). The quantified object is not attracted to spec-CP and therefore it is not accessible to operations outside an embedded CP.

In later papers, Chomsky has changed his mind about covert movement:

(161) At the phase level, two basic operations apply: transfer to the interface, and Merge, either external or internal [i.e. Merge and Move, respectively, K.R.C.]. If internal Merge precedes transfer, movement is overt; otherwise, it is covert. If movement is covert, transfer has already spelled out the lower copy; if overt, the choice is delayed to the next phase. (Chomsky 2005: 13, emphasis added; see also Chomsky 2004: 111)

The application of covert movement is, however, restricted:

(162) Covert movement to the escape hatch Spec-vP is possible for a direct object only if it undergoes further A'-movement [...]. Thus there is covert wh-movement but not covert Object-Shift [...]. (Chomsky 2004: 115, emphasis added)

I return to restrictions on covert movement in 2.3.10 below where I narrow down the applicability even further. In what follows, what I call PF-stranding corresponds to movement after transfer to the phonological component (= Spell-Out). In other words, it is 'post-Transfer internal Merge', which, as the name implies, applies to the formal features, not the already transferred phonological material.

2.3.7.3 Revising Covert Movement

The *revision* of covert movement is that it only applies to operators (quantifiers, negation, and *wh*-elements) and that it is stranding rather than movement. Covert QR, as described above, moves the formal and semantic/LF features of the object (Obj_{LF}) to the edge of *v*P, stranding its PF features (Obj_{PF}) in the base-position, which then becomes the spell-out position. In the outer spec of *v*P the covert object is accessible to the probing T^o (note that this is not the same as TH/Ex):



Danish *ingen* 'no(-thing/body)/none' licenses sentential negation and must be (or have a trace in case of subjects or topics) in spec-NegP, i.e. NEG-shift is obligatory. That means that it has checked EPP on Neg^o. In this position it is also available as a goal for the [uQuant] probe on Fin^o.



Danish *nogle* 'some' is a PPI and therefore it is not attracted to a NegP which is not projected in positive clauses. Probe-goal agreement between [uQuant] on Fin^o and *nogle* does not induce movement, as the object covertly moved to spec-vP (stranding its PF features) is available for long-distance agreement.



French *tout* 'all', *rien*_{zero}, and *beaucoup* 'many' (and Danish *ingen*_{zero}, see above), moves overtly to spec-*v*P and stays there. For *tout* and *beaucoup*, this operation is optional as they may also remain in situ.

2.3.8 On the Change from OV to VO

Pintzuk & Taylor's (2004) quantitative analysis of Old English shows that in the history of English, *negative objects, quantified objects* and *positive objects* do not have the same distribution: OV word order changes to predominant VO with positive (non-quantified, non-negative) objects before quantified objects, which in turn changes to OV before negative objects do. In other words, NEG-shift applies longer in English than QR does, and OV (and scrambling) with positive objects disappears first. "Van der Wurff (1999) made the important observation that the change from OV to VO did not affect all objects at the same time: negative and quantified objects continued to appear in pre-verbal position in Early Modern English, after non-negative non-quantified (henceforth 'positive') objects were all post-verbal" Pintzuk & Taylor (2004: 138). (The generalization in (166) does not apply to movement to CP.)²²

Base-generation / scrambling	>	QR >	>	NEG-shift	>	Strict VO
[+/-Quant]		[+Quant]		[+Quant]		
[+/-Neg]		[+/-Neg]		[+Neg]		
Old English	>	Middle Englis	h		>	Modern English

(166)

²² At first sight, Stylistic Fronting (SF) appears to be a counter example to the generalization, because SF has disappeared in all the Scandinavian languages except Icelandic while NEG-shift still applies (to varying degrees). However, unlike QR and NEG-shift, SF is motivated, neither by quantification [Quant] nor by negation [Neg]. According to Hrafnbjargarson (2004), SF is driven by a [Focus] feature on Foc^o in an articulated CP-domain (see chapter 3, section 3.2.3.2); therefore, like other CP related movement, it falls outside the generalization in (166).

This is compatible with my analysis. NEG-shift targets a position higher than QR and is driven a feature different from the one driving QR (the order in (166) is the reverse of the c-command relations between the target positions of the three movement types, namely, VP, vP, and NegP, respectively, cf. (152) above). It seems that VO order (head-compl) becomes fixed in a step-wise manner from the bottom up.

This also shows that NEG-shift cannot be a subcase of QR which is otherwise argued by Svenonius (2000): both are scope-driven. In fact, Rögnvaldsson (1987: 37) also states that in Icelandic, "the more negative quantifiers have a stronger tendency to precede the VP than the more positive ones [...]. This is of course also to be expected, since only the negative ones can be preposed in the other Scandinavian languages. But perhaps we can say that we have here two different tendencies; on one hand a tendency to prepose negatives [i.e. NEG-shift], and on the other hand a tendency to prepose quantifiers [i.e. QR]." ²³

"Under his analysis, the change in the beginning of the 15th century [in Old English] was [...] simply the loss of whatever mechanism derived pre-verbal positive objects" (Pintzuk & Taylor 2004: 139).

In the Old English period, "the shorter the object, the more likely it is to appear preverbally" (Pintzuk & Taylor 2004:142). In other words, the weight principle is also at work here forcing movement to be covert. (The text does not say whether stranding of complements, or rather application of TH/Ex, was possible.) Furthermore, in Old English and Old Norse (Rögnvaldsson 1987), QR and NEG-shift were optional in their overt versions (as far as it is possible to tell; there are no speakers to get scope judgements from). It could be taken to show that 'weight' and hence TH/Ex could apply to the whole quantified object, and not just the complement of the quantifier (or the NP selected by the quantifier), cf. that Pintzuk & Taylor (2004) argue that Old English allowed rightward movement of negative and quantified objects.

Another interesting example comes from Early Modern Danish in (167) below. Note that the quantifier *noget* (the neuter form of *nogen*) precedes the main verb which shows that the object has undergone QR:

²³ What remains to be explained is why quantified objects that are also NPI more frequently undergo QR than positive ones. One possible solution would be to adopt a version of the NEG-criterion (negative operators must be in spec-head with Neg^o, Haegeman & Zanuttini 1991) such that Neg^o has EPP for two specifiers, one for negation and one for the NPI quantifier. The NPI is attracted by Neg^o to the inner spec of NegP because of identity in [*u*Neg]. When negation is merged as the outer spec of NegP, it valuates and deletes [*u*Neg] on both Neg^o and the NPI. In this way, the NPI (though phonetically empty as the PF features are stranded in spec-*v*P or even inside VP), is still c-commanded by and thus in the scope of negation which gives the proper licensing and interpretation. However, solution has several serious problems: (a) NPI movement is rather spurious, as attraction is otherwise dependent on valuation and EPP, not identity in unvalued features; (b) the base-position of the negative adverbial is also problematic, see section 2.3.11 below; (c) multiple specifiers are only licensed at the edge of strong phases and NegP is not a strong phase.

The finite auxiliary has moved to T^o above vP as it it precedes the QR'ed object:



There are two interesting movements here: 1) an intermediate step between V°-to-I° (V°-to-Fin°) movement, which is found in Middle Danish and Icelandic, and verb in situ as in Modern Danish; and 2) the object has undergone overt QR, which is not possible in modern Danish. Old Norse also generally allowed OV word order (or had a double base), which is lost in Early Modern Danish which still allows QR. Now NEG-shift appears to be on the retreat (see section 2.2.4 above), which leads to generalized VO.

Interestingly, Christensen (1987; 15, footnote 1) also notes that overt QR was possible in Norwegian at an earlier stage. Christensen (1987: 8) furthermore argues that QR is movement to adjoin to VP which is much in line with the present proposal (movement to spec-vP rather than IP-adjunction):²⁴

²⁴ Western (1921) gives other examples of OV word order, including object shift across the verb (in violation of Holmberg's Generalization), e.g. *Med en viss krybende ærbødighed for ham som <u>pengene</u> hadde 'Lit.: With a certain crawling respect for him who the money had', even with pronominal objects, e.g. <i>Hadde hand et gjort,*

```
(169) No: En Mand med Rigets spidseste Pen lod sig

A man with kingdom-the's most.pointy pen let SELF
ikke <u>alting</u>1 [vP byde t1 ]
not everything offer

(Western 1921: 222)

(170) No: ...ingen kunde <u>andet</u> [vP si t1 ]
No.one could otherwise say

(Western 1921: 222)
```

2.3.9 Outline of a Typology of Quantifiers

The analysis presented above leads to the (incomplete) 'typology' of quantifier movement outlined in (171) below.

	NEG-shift	Obligatory overt QR	Optional QR
	(to spec-NegP)	(to spec-vP)	(to spec-vP)
Overt	Da. ingen		
	Fr. rien	Fr. rienzero	Fr. tout, beaucoup
	Ge. kein		Ge. kein _{zero}
	Ic. enginn		Ic. fáir, enginn _{zero} , margir,
			neinn, ýmislegt
	Po. nikogo	Po: coś	
Covert			Da. nogen, nogle
	En. <i>no</i> _{neg}		En. any, some
	Fr. aucun, personne		
	FS. <i>ingen</i> _{neg}		FS. ingenzero

(171) **NEG-shift and QR**

Covert movement only applies to elements that have wide scope but cannot move (e.g. English) or to elements that that can be ambiguous in situ and optionally move. English *no* and Finland Swedish *ingen* are special cases, typologically speaking, as the negative quantifiers do not move overtly to spec-NegP. They are always spelled out in a post-main-

hadde Norge været en provins rikere 'Lit.: Had he it done, had Norway been a province richer'. The examples are all from literary texts and may be deliberately stylistically marked.

verb position (in Finland Swedish, *ingen* may indeed move overtly, though string-vacuously, to spec-NegP when the main verb is in V2 position, though there is no empirical evidence to support this).

If the uninterpretable / unvalued [uNeg] on Neg^o is not valuated, sentential negation is not licensed and the derivation crashes. Therefore, the set of formal / LF features of the negative object moves to spec-vP where it is an accessible goal for [uNeg] probe. The EPPfeature on Neg^o induces (covert) movement of Obj_{LF} to spec-NegP where it is the goal of the Fin^o_[uQuant] probe once it has been merged above NegP, cf. (164) above:



Note that French *rien*_{zero} is also a special case. It's the only zero-quantifier (not sentential negation) that undergoes obligatory movement to spec-vP in the languages in question (Icelandic *enginn* may optionally move). The other zero-quantifiers stay in situ (LF as well as and PF features), as they do not have sentential scope. If it is assumed that narrow scope is determined by a [*u*Quant] feature on v^{o} , the quantifiers can enter into probe-goal agreement in situ as there is no intervening phase boundary. Is has to remain for future research to explain why French *rien*_{zero} moves to spec-vP.

The [*u*Quant] feature can be inserted on Fin^o (wide scope) or on v° (narrow scope), or in case a quantified object has to scope over a quantified subject, on C^o. Likewise, a [*u*Wh] feature may be inserted together with an EPP on C^o in 'normal' *wh*-questions, or without the EPP on v° in echo-questions. In 'normal' *wh*-questions in Danish, French, and English, the *wh*-element obligatorily moves overtly to spec-*v*P and from there to spec-CP. In French main clauses (but not in embedded clauses), *wh*-elements may sometimes optionally move covertly to spec-*v*P (see Rizzi 1991).

In Polish there is also optional *wh*-movement when there is more than one *wh*-phrase. However, unlike in French for example, *wh*-elements cannot remain in situ. The first (highest) *wh*-element undergoes obligatory movement to spec-CP while the second *wh*-element undergoes obligatory overt movement to spec-*v*P and only optionally to spec-CP ((174)a is acceptable if *komu* "carries heavy, focal stress", Dornisch 2000: 47):

(174)Po: a. *Co Anna poleciła komu? by b. Со by Anna komu poleciła? c. %Co poleciła? komu by Anna (Dornisch 2000: 47, (1)) What to-who would Anna recommend

In Chinese and Japanese, it moves covertly to spec-*v*P and to spec-CP. (Note that Japanese is an OV language.)

(175) Ch: [cp C°[+Wh] [Zhāngsān kàn shéi]]?
Zhangsan see who
"Who did Zhangsan see?"
(Comrie 1989: 64)

(176) Ja. [cp [John-wa [vp nani-o kaimashita]] ka]? John-TOPIC what-NOM bought Q "What did John buy?" (Poole 2002: 170, (3))

C^o may then have two EPP-features, which is not possible in V2 languages but found in many non-V2 languages, such as Bulgarian, Chinese, Czech, Hungarian, Japanese, Polish, Romanian, Russian, Serbo-Croatian, etc. (see Haegeman 1995: 102 and references cited there). Note that the licensing of multiple specifiers may be a property of strong phase heads only: other positions are available for long-distance agreement *within* a strong phase.²⁵

²⁵ This means that object shift (OS) cannot be analyzed as movement to spec-FinP (the highest projection in the IP-domain) which would require Fin^o to have multiple specifiers: one for the subject (the outer spec) and one for the object (the inner spec). In section 2.5.1 I argue that OS targets the specifier of a functional head π^{o} between FinP and NegP.

(177) **Constraint on Multiple Specs:**

Only strong phase heads can have multiple specifiers

The constraint on multiple specs in (177) is subject to parametric variation: whether C^o has one or two specs depends on parameter setting.

This leads to a similar typology of operator movement to spec-CP:

	Obligatory to spec-CP	Obligatory to spec- <i>v</i> P	Optional to spec-CP
			(in situ)
Overt	Da. hvem		
	En. who		
	Fr. qui		Fr. qui
	Ge. wer		
		Po: <i>komu</i>	
Covert	Ch. shéi		
	Ja. <i>nani</i>		

(178) *Wh*-movement

2.3.10 Summary

It is important to note that covert movement, i.e. stranding of PF features, is **only possible with operators**. Heads move *if and only if* the probe is 'strong' (that is, affixal or incorporating), nominals, NPs and DPs, move *if and only if* the probe has an EPP-feature (and if there is no expletive available in the numeration; note that this also means that there is no movement of the associate to replace the expletive or to adjoin to it at LF). Operator movement has **significant consequences for interpretation**, which is not the case for head movement. When operator movement is blocked, operators are (sometimes) ambiguous in situ, indicating covert movement. This exception to the collapse of covert and overt movement, an apparent 'imperfection' of the computational system, is thus **empirically motivated and constrained to operators**.

If *wh*-elements are indeed quantifiers (e.g. Chomsky 1995: 70), the licensing of phonological stranding and covert movement is narrowed down even further:

(179) Only quantifiers may strand their phonological features

The target of QR is a position at the edge of the strong vP phase where QPs can enter into long-distance agreement with a probing [*u*Quant]. Assuming multiple specifiers, a necessary consequence of the PIC and EPP-driven XP movement, and constrained by the *Constraint on Multiple Specs* in (177), there is no αP : the target of QR is the outer specifier of vP.

QR and NEG-shift are driven by semantic interpretation (and feature valuation and EPP checking) and is obligatory and universal (cf. the *Uniformity Principle*). Both operations must take place, overtly or covertly, to ensure convergence. The choice between overt movement (pied piping of PF features) and covert movement is a question of **parameter setting** (cf. also the difference between scrambling and object shift where only the latter is subject to prosodic constraints), determining whether covert movement is licensed, and **idiosyncrasies** in the lexical entries, accounting for the language-internal variations.

Thus, overt operator movement itself is not driven by syntactic or semantic requirements; it is motivated by what might be pragmatic constraints ("Avoid Ambiguity", cf. section 2.4.2 below) and prosodic constraints on stranding, that is, requirements for PF convergence. Strictly speaking, this is a departure from what is standardly associated with PF, namely, morphology. However, the proposal does not entail movement in the PF component. Furthermore, it does seem to be a paradox that phonetic requirements depend on syntactic notions such as c-command, but in fact it is not. All movement is subject to syntactic constraints (e.g. x-bar structure, the Extension Condition: movement and structure building are always upwards, Economy of Derivation: movement is always last resort, etc.). There is only movement in the narrow syntax $(N \rightarrow \lambda)$; there is no "PF movement" (except, perhaps, right-dislocation / "Heavy-XP shift", as noted in section 2.3.7.2 above, which is not directly reducible to linearization). However, movement may be triggered for phonological and/or prosodic reasons. Pied-piping of PF features is motivated by prosodic constraints which are applied in parallel with syntactic constraints (as indeed proposed by Ralf Vogel (2003) for pronominal object shift and scrambling). Post-Spell-Out operations in the PF component are strictly morphological and phonological. It is important to stress that both overt and covert movement are syntactic, not phonological, processes, i.e. instances of the process of Move (as opposed to Merge), which is a central process of narrow syntax.

There are two different motivations for covert movement: (i) **PF-stranding** which is involved in covert movement of quantifiers, *wh*-elements, negative objects,²⁶ and (ii) **TH/EX** which extracts and right-adjoins phonologically heavy elements, e.g. "Heavy-XP shift" of

²⁶ The same may also be the case for German scrambling and Icelandic object shift of definite full DPs. The availability of PF-stranding depends on how Holmberg's Generalization is parameterized.

subjects, and extraction of heavy complements of quantifiers, leaving the formal feature bundle for further **covert** syntactic processing (dotted arrows indicate covert movement, full arrows indicate overt movement.



2.3.11 The Base-position of Negation

The theory of valuation as outlined in section 2.3.6 above is based on c-command: The unvalued feature probes within its c-command domain for a matching goal to valuate it. However, this leads to a problem with the negation marker and the valuation of [uNeg] on Neg^o. Merging the negation marker, e.g. *ikke* 'not', as spec-NegP will place it outside the domain of Neg^o and it will not be available as a valuating goal for [uNeg].²⁷

The problem could be solved by having two versions of Neg^o. The convergence requirement ensures that Neg^o in numerations with *not* (and its equivalents in the other languages), has a valuated, and therefore non-probing, [+Neg] feature. The unvalued [uNeg] feature is inserted on *not*. This is the mirror image of what happens with negative objects and is clearly *ad hoc*.

What I propose instead is that the negative adverb *ikke* is merged as an adjunct of vP (or some other projection below NegP, or possibly as the specifier of some functional projection), where it is inside the domain of Neg^o. [*u*Neg] on Neg^o probes for a valuating match and finds *ikke*, and the EPP on Neg^o attracts it to spec-NegP.²⁸

²⁷ The only spec-head checking that is possible is one that does not require valuation, namely, EPP checking. The EPP merely requires the specifier to be filled by a nominal XP.

²⁸ In fact, Rögnvaldsson (1987:10) makes a somewhat similar proposal, namely, that "it might be possible to assume that [negation and other adverbials] are also generated further to the right, and then moved to preverbal position."



This accounts for the parallel between *aldrig* 'never' and other adverbials related to time or frequency (or manner or place), which are adjoined lower and can (and sometimes must) be sentence-final (possibly right-adjoined to vP); also, the conditional *under ingen omstændigheder* 'under no circumstances' would be generated low on a par with *under visse omstændigheder* 'under certain circumstances' and subsequently attracted to spec-NegP.

- (182) Da: a. *Jeg har været i Norge <u>aldrig</u> b. Jeg har <u>aldrig</u> været i Norge I have never been in Norway
- (183) Da: a. Jeg har været i Norge <u>i en uge</u>
 b. ?Jeg har <u>i en uge</u> været i Norge
 I have in a week been in Norway
 "I've been in Norway for a week."
- (184) Da: a. Jeg kan <u>under ingen omstændigheder</u> løbe hurtigere end dig I can under no circumstances run faster than you
 - b. *Jeg kan løbe hurtigere end dig under ingen omstændigheder
 - c. Jeg kan <u>under visse</u> omstændigheder løbe hurtigere end dig I can under certain circumstances run faster than you
 - d. Jeg kan løbe hurtigere end dig under visse omstændigheder

Adverbs are merged in the positions corresponding to their scope, i.e. adjoined to vP ("VP-adverbials") or NegP/TP (sentential adverbials). Negative adverbials, however, must be merged low in the domain of Neg^o in order to be able to valuate Neg^o and check the EPP. Merging a negative adverbial directly as spec-NegP would delete the EPP-feature but leave Neg^o unvalued and the derivation would crash.

This analysis can also account for the scope differences associated with the different orders of subject and negation in Norwegian and Swedish. Eide (2002) shows that these two languages allow adverbials to either precede or follow the subject. When negation follows the subject, the scope of negation is ambiguous. This also holds for Icelandic (Gunnar Hrafn Hrafnbjargarson, p. c.).

(185) No: a. Dermed kan medisinen ikke virke. Thus can medicine-DEF not work "Thus, the medicine can not work" (ambiguous: possible-not /not-possible)

b. Dermed kan ikke medisinen virke.
Thus can not medicine-DEF work
"Thus, the medicine cannot work" (unambiguous: not-possible)

(Eide 2002: 225, (1a, b))

Instead of allowing multiple adjunction sites for negation (and other adverbials), what I propose is that the subject can occupy two positions, namely, spec-TP and spec-FinP (which is evidently the case in Icelandic in e.g. transitive expletive constructions). Spec-TP is a potential floating site for subject quantifiers, which shows that the subject moves through it on the way to spec-FinP, the canonical subject position. When the subject is in spec-FinP, it precedes negation as in (185)a. The difference between having negation in spec-NegP, which gives the wide-scope (sentential negation) reading and having negation adjoined to vP, which gives the narrow-scope reading, is string-vacuous. Hence, the string is ambiguous. If, on the other hand, the subject is in spec-TP, as in (185)b, which is between NegP and vP, the ambiguity dissolves. If negation precedes the subject, it must be in spec-NegP and have sentential scope.



In addition, this approach is compatible with that of Cormack & Smith (2002) who argue that there are three negative projections, one adjoined to VP (like other VP-adverbials), one is NegP, and the third is a meta-negation ("echo-negation") in the CP-domain. The first (VP-adjunction) and the third (CP) are built by Merge, while the second, i.e. spec-NegP in the present case, is filled by movement in order to valuate Neg^o, check the EPP (which by this account is always present on Neg^o), and give the right scope relations, viz. sentential negation.

There are thus only two instances where adverbials are not inserted in their scope positions: (i) negatives, which need to be c-commanded by Neg^o to enable valuation of [uNeg], and (ii) adverbials with scope wider than the IP-domain, which must be topicalized²⁹ and this is possible because C^o has an EPP-feature licensing a specifier.

²⁹ Generally, nothing can be inserted into CP, only movement can fill positions in CP. There are a few exceptions to this, namely, complementizers (signalling embedding) and force indicators in C° and empty question operators in spec-CP in *yes/no* questions (the latter could also be moved to spec-CP as an event variable, cf. Higginbotham 1985.) Also, the Icelandic expletive $pa\delta$ is arguably inserted directly into spec-CP rather than moving there from a lower position; support for this comes from the fact that Icelandic allows the sequence [CP $pa\delta$ Verb [FinP Subj Negation/Adv ...]] (e.g. Hrafnbjargarson 2004: 27-28, Sigurðsson 1989: 300-303). The German expletive *es*, is yet another exception: when there is no topic, *es* is inserted in spec-CP. That it is indeed in spec-CP and not in spec-FinP can be seen from the fact that nothing else can be topicalized when the expletive *es* is present:

(i)	Es	ist ein Brief	gekommen	(no topic, es in spec-FinP)
(ii)	Ein Brief	ist	gekommen	(topic=ein Brief, no expletive)
(iii)	*Ein Brief	ist es	gekommen	(topic=ein Brief, es in spec-FinP)
	A letter	is it	come	

2.3.12 Negative Quantifiers and FG

In this section I shall digress somewhat and examine how Dik's (1997) functional grammar (FG; see chapter 0, section 1.4.1.3) applies to negation and negative quantifiers. I shall argue that the analysis offered by FG is inadequate. Consider the following example taken from Dik (1997: 385, (48)) (the string in (187)b is the FG representation):

(187) a. John did not buy the book b. Neg Past e_i : buy [V] (John)_{AgSubj} (the book)_{GoObj}

According to Dik (1997: 385-386), the representation in (187)b "expresses that Neg takes the whole predication in its scope, but is nevertheless rather closely associated with the predicate, just like the Tense operator Past". In other words, negation has sentential scope.

Consider next what happens in zero-quantification: "Note that we do not use the operator Neg for such constructions as [(188)a]. [...] Rather, we regard [(188)a] as containing a zero-quantified term [i.e. negation is inserted at level 0, K.R.C.], as represented in [(188)b] [...] where the zero-quantifier indicates that the set of books (which one might think John might have bought) was in fact empty. There will thus be no equivalent to so-called "Neg Incorporation" in such constructions as [(188)a]."

(188) a. John has bought no books b. Past e_i: buy [V] (John)_{AgSubj} (\emptyset_i : book [N])_{GoObj}

Kahrer (1996) also offers an analysis of negation and zero-quantification. "Rather than being viewed as objectively stating the non-occurrence of a SoA [state of affairs, K.R.C.] [...] examples such as [(188)a] may be seen as constituting a positive statement about the size of of a set denoting a participant in a SoA. Under this assumption, term negation [constituent negation, K.R.C.] [...] qualifies as a type of quantification, zero quantification, and may be handled analogously to other quantifiers, such as *all, many*, and *some*" (Kahrer 1996: 25).

Kahrel (1996: 32) follows Dik in arguing that there are "two strategies of talking about nothing":

(189) Strategy a: 'Think about any arbitrary book; I tell you that John did not buy it.'Strategy b: 'Think of the set of books that John might have bought; I tell you that that set is empty (i.e. has no members).'

Kahrel states that these strategies apply to examples such as (187)a, (188)a, (190)a, and (191)a:

- (190) a. I did not see someone/anyone b. X: past NEG e: seev (I)_{Ag} (i/gx_i: human)_{Go}
- (191) a. I saw nobody b. X: past e: seev (I) $_{\rm Ag}$ (Øx_i: human) $_{\rm Go}$

"Formally, [(190)a] does but [(191)a] does not contain a negative operator; semantically, [(191)a] is a set expression, [(190)a] is not. In spite of these differences, both strategies have the same communicative value, namely to say 'nothing' or 'no one'." (Kahrer 1996: 32)

The are two problems with this analysis. The first one is that, as I have argued in section 2.3.5 above, zero-quantification is only possible with scalar entities: I find it very difficult to see how (188)a and (191)a can be "set expressions" with the former meaning that John bought zero books (and therefore paid for nothing), and the latter meaning that I actually perceived zero people, something that is virtually impossible.

The second problem is that the analysis does not capture the ambiguity of the scope of the negative quantifier: It can always mean the same as *not...any* and sometimes mean *zero* – i.e. the difference between sentential and constituent negation / zero quantification. It is problematic that there is not a negative operator at level 2 to license the sentential negation reading of e.g. *nobody* in (191)b. The difference between level 2 (sentential negation) and level 0 (zero-quantification) would correspond neatly with the derived position and base-position of Danish *ingen* 'no'.

2.3.13 Some Remaining Issues

2.3.13.1 Quantified Subjects and Locality Effects

The analysis applies to quantified subjects as well, except that they do not need to move to the edge of *v*P because they are merged there to begin with. Problems arise when both subject and object are quantified because if the object is to scope over the subject the *Minimal Link Condition* (Locality/Relativized Minimality) will have to be violated.
(192) Minimal Link Condition (MLC)

K attracts α on if there is no β , β closer to K than α , such that K attracts β . (Chomsky 1995: 311, (110))

That is, only (193)a is accounted for, not (193)b:

(193) All the guests tasted some of the chips.a. All the guests tasted more than more one kind of chips.b. There were some kinds of chips that all the guests tasted.

The quantified subject is in spec-TP when Fin^o with [uQuant] is merged, and thus the subject is the closest match and goal for the probe which attracts to check the EPP-feature. However, the subject will also be the closest match for the probing [uQuant] on C^o. The quantified object in spec-vP is inaccessible under the MLC.



There are at least two possible solutions to this problem: 1) Case and visibility, or 2) Indiscriminate edge-features. Under solution 1, DPs are inactive / invisible once they have been assigned Case. Assuming that nominative Case is licensed by Fin^o (perhaps by "inheritance" from C^o), the subject in spec-FinP is invisible and therefore it does not intervene between the probing [uQuant] and the quantified object. However, the object is assigned Case inside VP which means that at the stage where Fin^o has been merged, the object does not have unvalued Case [uCase] and it is therefore invisible as well. That leads us to solution 2. According to Chomsky (to appear):

(195) the edge-feature of the phase head is indiscriminate: it can seek any goal in its domain, with restrictions (e.g. about remnant movement, proper binding, etc.) determined by other factors. Take, say, Topicalization of DP. EF [i.e. the Edge Feature = EPP, K.R.C.] of a phase head PH can seek any DP in the phase and raise it to SPEC-PH. There are no intervention effects, unless we assume that phrases that are to be topicalized have some special mark. That seems superfluous even if feasible. [...] Note that there should be no superiority effects for multiple wh-phrases; any can be targeted for movement. [...] That leaves the problem of

explaining the superiority phenomena in the languages in which they appear: English, but apparently not German in simple cases, for example. (Chomsky, to appear: 17; emphasis added)

As QR is operator movement like *wh*-movement, they should be expected to play by the same rules. Furthermore, as this "indiscrimination" is not restricted to operators but also applies to topicalization, as is well known, there seems to be no apparent reason to not assume it to hold for QR. The problem seems to be that QR is not driven by an edge-feature, but by an uninterpretable feature of a probing head (assuming my analysis to be on the right track). However, that may not be a problem after all if it is assumed that "the edge- and Agree features of the probe can apply in either order, or simultaneously, with only certain choices converging" (Chomsky to appear: 17). Thus, the edge-feature / EPP-feature attracts the object while C° [*u*Quant] agrees with it simultaneously. As Chomsky notes, "there is nothing problematic about application of features" (Chomsky, to appear: 17, note 44).

According to Chomsky (2004: 123, see also Chomsky, to appear: 9), "Spell-Out applies at the phase level (by definition), and as discussed, all operations within the phase are in effect simultaneous. Furthermore, their applicability is evaluated at the phase level, yielding apparent countercyclic effects within the phase [...]. The phenomenon is illustrated simply by A'-movement to Spec-C [...]". In a (simplified) structure such as (196) below, the subject *he* raises to spec-TP across *what* in the outer spec-*v*P in apparent violation of the MLC; next, *what* moves to spec-CP across *he* voiding the MLC violation at the CP phase level.

(196) En:



There is also a different and more general problem. For some reason, when the object is a negative indefinite quantifier with sentential scope, say, *ingen*, the subject cannot be a universal quantifier too, and therefore floating quantifiers (FQs) do not co-occur with NEG-shift:

(197) Da: a. *<u>Alle</u> har <u>ingenting</u> fået
 Everyone has nothing gotten
 *"Everybody didn't get anything"

- b. *De har <u>ingenting</u> alle fået
 They have nothing all gotten
 *"They all didn't get anything"
- c. <u>Alle</u> har fået <u>ingenting</u> Everyone has gotten nothing "Everybody got nothing (zero)"

FQs induce a freezing effect and NEG-shift is blocked and only narrow scope readings (zeroquantification, see section 2.3.5 above) are possible:

(198) Da: Har de <u>alle ingenting</u> fået (*overhovedet)?
Have they all nothing gotten (at all)
"Did they all get nothing?" / *"Did they all not get anything at all?"

The FQ *alle* is in spec-TP and the NegQP in spec-*v*P; there is no (sentential) NegP and the sentence is synonymous with the corresponding example where the NegQP is in situ:

(199) Da: Har de <u>alle</u> fået <u>ingenting</u> (*overhovedet)
Have they all gotten nothing (at all)
"Did they all get nothing (i.e. zero) (*at all)"

(In Icelandic the effect is even stronger and (198) is ungrammatical under either narrow or wide scope reading.)

With a *wh*-subject, however, things are better:

(200) Da: Hvem har (??alle) ingenting (*alle) fået overhovedet? Who has (all) nothing gotten at.all "Who didn't (all) get anything at all?"

Here the problem appears to be one of co-reference between the *wh*-element and the quantifier: both refer to the whole set of referents and compete for scope. Note also that *alle* must be in spec-FinP while *ingenting* is in spec-NegP; the order of the two cannot be reversed.

2.3.13.2 A Note on *ingen* and Presupposition

According to Jónsson (1996: 82), "negative object movement affects semantic interpretation":

(201) Ic: a. Jón hefur <u>engra Marsbúa</u> leitað
 Jón has no Martians.GEN looked-for
 → presupposes the existence of Martians: ∃x, x=Martian

b. Jón hefur <u>ekki</u> leitað <u>neinna Marsbúa</u>
Jón has not looked-for any Martians.GEN
→ does not presuppose the existence of Martians

Jónsson mentions one exception to this 'rule' (1996: 83, fn. 36):

However, I claim that there is no difference in meaning. Both the *no* and the *not any* version are compatible with situations where the negated object refers to something either in the world or in the universe of discourse. First of all, if NEG-shift did have this semantic effect, the following examples should also show this contrast which, in my judgement, they do not. Neither presupposes the existence of angels. Furthermore, if they did, the *because*-clauses would render them semantically anomalous:

 Furthermore, the following examples would be predicted to be semantically ill-formed, which is not borne out:

 (204) Da: a. ...fordi der <u>ingen gode argumenter</u> findes for det ...because there no good arguments exist for it
 b. Man kan <u>ingen gode argumenter</u> finde for det One can no good arguments find for it

The difference between *ingen* and *ikke nogen* appears to be only **stylistic**, not semantic, in nature.

Jónsson's difference in interpretation in (201) (which is the only relevant example he provides) may have something to do with the case on the object. *Leita* 'look for' assigns genitive case to the object which may induce a partitive reading, viz. "none of the Martians", which naturally presupposes the existence of Martians. If the example is constructed with a verb that assigns accusative case, such as *finna* 'find', the presupposition disappears:

(205)Ic: a. Jón hefur <u>enga Marsbúa</u> fundið Jón has no Martians.ACC found \rightarrow does not presuppose the existence of Martians b. Jón hefur ekki fundið neina Marsbúa Jón has not found any Martians.ACC \rightarrow does not presuppose the existence of Martians (Gunnar Hrafn Hrafnbjargarson, p.c.) (206)Ic: a. Fundirnir hafa engan árangur borið Meetings-the have no progress.ACC brought \rightarrow does not presuppose progress b. Fundirnir hafa ekki borið neinn árangur Meetings-the have not brought any progress.ACC \rightarrow does not presuppose progress

(Gunnar Hrafn Hrafnbjargarson, p.c.)

Coreference, rather than presupposition, may be licensed **pragmatically** in certain contexts rather than by the semantics of the negative quantifier or by the syntax of NEG-shift itself.

2.3.13.3 A Note on NEG-shift and Clause-boundedness

In Icelandic and Danish, NEG-shift cannot escape a finite embedded clause:

She has nothing meant

(207) Ic: *Hún hefur <u>enga peninga</u>1 sagt [_{CP} að hún hafi fengið t₁] She has no money said that she has received
(208) Da: a. *Hun har <u>ingen penge</u>1 sagt [_{CP} at hun har fået t₁] She has no money said that she has received
b. *Hun har <u>ingenting</u>1 ment [_{CP} at jeg skulle gøre t₁]

However, NEG-shift is not clause-bound in control infinitives (cf. Jónsson 1996: 85, Kayne 1998: 142).

that I

should do

Apparently, the Icelandic sentence is ambiguous and can mean the same as either of the two unambiguous Danish examples:

(210) Da: a. De har forsøgt [cp t1 PRO intet1 at gøre t1]
They have tried nothing to do
"They have tried not to do anything."

b. De har <u>intet</u>₁ forsøgt [_{CP} t₁ PRO at gøre t₁]
They have nothing tried to do
"They have not tried to do anything."

This raises the question about the landing site. As neither Icelandic nor Danish has negative concord, there can be only one NegP is the structure, namely, the NegP in the relevant scope position.

To reach the target spec-NegP of the matrix clause, the negative object in the embedded clause must first move to the outer spec-vP (to escape the trong vP phase) where it is accessible for to the probing (embedded) C° which attracts it to check EPP inserted as Last Resort to ensure that the object is available outside the embedded CP phase. From spec-CP in the embedded clause, the object moves to the outer spec of the matrix vP to be available as a goal for the probing Neg° attracting it to spec-NegP. In short, the NegQP must first be topicalized in the embedded clause which is rather unusual. This derivation yields the wide scope interpretation, i.e. NegP is in the matrix clause.

What about the other interpretation, the one which has the narrow scope reading even though the negative object is clearly in the matrix clause? The answer I propose is that the object has undergone **NEG-shift in the embedded clause** (through spec-vP to spec-NegP) and **QR into the matrix clause**: the object moves from spec-NegP to spec-CP to check EPP; from here, it is attracted to the outer spec of the matrix vP as Last Resort to make it available for a probing [uQuant] feature.

Interestingly, as illustrated in the following example (from Kayne 1981; see e.g. the discussion in Haegeman 1995: 230), French *personne* in an embedded **finite** clause can be associated with the negative head *ne* in the matrix clause and hence have matrix scope:

That is, *personne* must undergo covert NEG-shift via spec-vP and spec-CP of the embedded clause to spec-NegP of the matrix clause where it checks EPP.

The question still remains why extraction is not blocked in control infinitives. At present I have no answer to this question. However, as pointed out to me by Sten Vikner (p.c.), it is interesting to note the resemblance of NEG-shift out of a control infinitive to the German so-called **third construction** (Ge: *die dritte Konstruktion*) which is also licensed by control verbs. In the third construction the object of the embedded infinitive scrambles up into the matrix clause and the remnant of the infinitival clause is right-dislocated (Wöllstein-Leisten 2001). Otherwise, scrambling in German (and e.g. Dutch, but not in e.g. Russian, cf. Müller 1995: 131-142), unlike *wh*-movement, is also strictly clause-bound (see e.g. Vikner 1994: 487, 2005: section 2.4.1, Müller 1995: 126-131 and references cited there). Compare NEG-shift out of control infinitives in (209)a and (210)c and the third construction in (212)c:

(212) a. In situ:

...weil er [VP [die Treppe mit schwartzer Schucreme ...because he the stairs with black shoe.polish

zu bestreichen] versucht] hat
to polish tried has

b. Right-dislocation:

...weil er $[_{VP} t_1$ versucht] hat ...because he tried has

[die Treppe mit schwartzer Schucreme zu bestreichen]1
the stairs with black shoe.polish to polish

c. The third construction:

...weil er [die Treppe]₁ [vp t₂ versucht] hat ...because he the strairs tried has [t₁ mit schwartzer Schucreme zu bestreichen]₂ with black shoe.polish to polish

Müller (1995) argues that Russian allows CP as an adjunction site for scrambling which in turn allows it not to be clause-bound. In the present framework where XP movement is always movement to a specifier position (i.e. driven by EPP-features), CP in Russian has multiple specs (as mentioned in connection with (177) above), while German CP only has one specifier (the V2 parameter). Assuming my analysis of control infinitives in chapter 3 (see especially (513)) is on the right track (and is universal, or at least applies to German as well as Icelandic) there is indeed an available spec-CP to function as an escape hatch in control infinitives:

However, it remains to be explained why scrambling to spec-CP is only licensed in control infinitives. The problem does indeed appear to be completely parallel to the problem of why NEG-shift through spec-CP is allowed (i.e. is not clause-bound) only in control infinitives.

(See also (530) in chapter 3, section 3.3.5.1, for a somewhat similar example with object shift.)

2.4 NEG-shift, Licensing, and Repair Strategies

2.4.1 Introduction

In this section, I will entertain the idea that there might be surface or representational constraints that are not directly related to case licensing or feature checking. Features that are strong, including EPP-features, need to be checked regardless of the position of the main verb. Nonetheless, the position of the verb determines or licenses the possible positions for the object. This conundrum has led researchers to various proposals to account for object shift (e.g. Holmberg 1999, Chomsky 2001, Svenonius 2000a, Vikner 1989, 1994, 2001a, Vogel 2003 among many others). Some agree that what might be influencing object licensing are constraints related to phonology. In section 2.3.7 above, I argued for an analysis along the same lines arguing that phonology influence syntax which has important implications for the architecture of the computational system and the notions of overt and covert movement. In chapter 3, section 3.2.4, I argue that parameter settings on constraints on information structure or on the interface between syntax and pragmatics determine whether a language allows semantically light constituents to act as a topic. Here I adopt a surface constraint analysis of the cross-linguistic variation in the licensing of NEG-shift. It is a 'functional' account in the sense that it is an analysis of conflicting constraints on information structure (structure preservation and unambiguous encoding) on the one hand and 'core' syntactic constraints on the other (economy and locality).

2.4.2 The NEG-Criterion

In section 0, I showed that in Danish negative indefinite objects (with neutral stress) must move out of the canonical object position in VP to a sentence medial position to license sentence negation, that is, undergo NEG-shift. The same holds in (most of) the Scandinavian languages (cf. e.g. Hansen 1984: 58, Thráinsson, Petersen & Hansen 2004: 246-247, Jónsson 1996: 81-99, Rögnvaldsson 1987, Christensen 1986, 1987, Svenonius 2002, and Holmes & Hinchliffe 2003: 164-165, 477-479).

In main clauses with non-compound tense, i.e. with the main verb in V2 position, it is string vacuous, as in (214), whereas in clauses with compound tense, NEG-shift moves the object across the main verb, as in (215): 30

(214) Da: Han læstev sikkert <u>ingen bøger</u> [vp tv t₁] He read surely no books
(215) Da: Han havde sikkert <u>ingen bøger</u> [vp læst t₁] He had surely no books read

The reason why NEG-shift is string-vacuous with the main verb in V2 position is that NEGshift does not cross any overt material, only traces of movement. The verb has moved to C^o and none of the adverbials that normally function as indicators of movement intervene: sentential adverbials are adjoined to NegP (or to TP in positive clauses) and therefore they precede spec-NegP; so-called VP-adverbials (e.g. manner and place adverbials) are rightadjoined to *v*P because they are always sentence-final in Danish (with a very few exceptions, cf. chapter 3, section), and therefore they always follow the object (alternatively, they are generated/merged low in the structure).

I assume an articulated IP-domain where NegP is sandwiched between TP which houses tense features, and FinP housing finiteness and the canonical subject position (see chapter 3, section 3.3.3.1, for argumentation). As I showed in section 2.3, XP movement out of vP must go through the outer specifier of v° :

³⁰ All example clauses are to interpreted in the sense where they can take a negative tag, such as *and neither did she* or *but she did*.



When the main verb is non-finite, it remains inside vP; the finite auxiliary, on the other hand, moves to C^o to satisfy the V2 requirement. With the verb remaining low, NEG-shift becomes overt (non-string-vacuous):



The target of NEG-shift is spec-NegP (e.g. Haegeman 1995, Jónsson 1996: 86, Kayne 1998: 134, Platzack 1998: 164). This is the same position where adverbials licensing sentential negation, such as *not*, are merged. Negation being a fairly important piece of information, the requirement that the presence of NegP be marked either on spec-NegP or on Neg^o, seems rather intuitive; some sort of a 'Doubly Non-filled Neg Filter' or a 'Mark NegP Constraint' rules out structures with a completely silent NegP. This is also captured in the NEG-criterion proposed by Liliane Haegeman & Raffaella Zanuttini (1991):

(218) **The NEG-criterion**

Each NEG X^o must be in spec-head relation with a NEG operator and vice versa. (cf. Haegeman & Zanuttini 1991: 244, Haegeman 1995: 106)

As Neg^o is the head that projects NegP, it is always merged in negative clauses. It then follows that the NEG-criterion can be satisfied either by merging something as spec-NegP, an overt operator such as *not* or *never* or an empty operator OP in case Neg^o is overtly realized as e.g. -n't, or by moving something into spec-NegP, say, a negative quantifier phrase in Scandinavian. Both spec and head position can not be filled at the same in the Scandinavian languages and English because these languages do not have Negative Concord (multiple negations, negative agreement). Here (unlike in French) it could be argued that a 'Doubly-filled Neg Filter' rules out such structures (on a par with the 'Doubly-filled COMP filter' which does not apply universally either).

Note that the NEG-criterion is what we might call a 'functional' requirement, a constraint on information structure: its function is to make sure that NegP is overtly marked and that there is no ambiguity about the location and scope of NegP (all operators of the same clause are in spec-head relation with the same Neg^o). That is, it can be taken to be a syntactic instantiation of the Gricean *Maxim of Manner: 'Avoid Ambiguity'* (Grice 1989: 27, Levinson 1983: 102; see also Gärtner 2003, 2004 who proposes a syntactic version of the maxim in an Optimality Theory, in the form of a family of constraints, to account of Icelandic object shift and object marking in Tagalog).³¹ The formal requirements on movement, strong or affixal head features, spec-licensing EPP-features, locality, etc., are in sense orthogonal to the functional requirement. For example, the NEG-criterion requires movement to spec-NegP and the formal principles and requirements determine how it is done:

(219) The hypothesis is that C-I [the Conceptual-Intentional interface, K.R.C.] incorporates a dual semantics, with generalized argument structure as one component, the other being discourse-related and scope properties. Language seeks to satisfy the duality in the optimal way, EM [External Merge = 'base-generation', K.R.C.] serving one function and IM [Internal Merge = Move, K.R.C.] the other, avoiding additional means to express these properties. (Chomsky, to appear: 7)

³¹ The Maxim of Manner is "Be perspicuous, and specifically: (i) avoid obscurity, (ii) avoid ambiguity, (iii) be brief, (iv) be orderly". Levinson (1987: 103) argues that the Gricean Maxims of Conversation (Quality, Quantity, Relevance, and Manner) have "universal application, at least to the extent that other, culture-specific, constraints on interaction allow." According to Gärtner (2004: 154) "this [analysis (of iconicity) in terms of a family of (disambiguation) constraints called "Unambiguous Encoding" (UE)] is attractive to the extend that UE could be taken to be grounded in Gricean principles like "be perspicuous", or "Avoid Ambiguity".

I thus assume a revised version of the NEG-criterion making it a requirement on overt realization such that it can not be satisfied by merging an empty operator in spec-NegP (except if Neg^o is overt):

(220) **The NEG-criterion (revised)**

NegP must be (maximally) overtly marked

Merging overt material in spec-NegP and/or Neg^o clearly satisfies the constraint. It may be less clear how movement through NegP satisfies it. However, when a verb moves through Neg^o picking up a clitic version of negation, sentential negation is marked in a clause-internal position c-commanding Neg^o making reconstruction possible. Sentential scope can be read off directly as the c-command (scope) domain of NegP is included in the domain of the spell-out position of the clitic Neg^o. The same story applies to, say, a negative subject which must check EPP on Fin^o where it c-commands NegP.

I leave aside negative inversion: in English, a negative element in spec-CP would potentially lead to ambiguity as to whether or not the [Neg] feature on the fronted element has sentential scope. This is resolved by moving the verb to C^o indicating sentential scope.

(Positive polarity:	221) En: a. With no examples will this analysis work
constituent negation)	= There are no examples such that this will work.
(Negative polarity:	b. With no examples, this analysis will work
sentential negation)	= This works without examples.

In Danish, this way of disambiguation is out because of the V2 requirement. Instead, Danish uses *verum*-focus which is focus on the polarity of the clause: If the clause is negative, the fronted negative element gets main stress; when the clause is positive, the finite (auxiliary) verb gets main stress. Compare (222) and (223) (capitals indicate verum focus / focal stress):

(222)	Da:	a.	Jeg	har	IKKE fåe	t	nogen	point	(Negative polarity)
			Ι	have	not rec	eived	any	points	
		b.	Jeg	HAR	fået	nogl	Le poi	nt	(Positive polarity)
			Ι	have	receive	d any	poi	nts	

(223)	Da:	a.	INGEN	point	har	jeg	(*allerede)	fået	(Sentential negation)
			No	points	have	I	already	received	
		b.	Ingen	point	HAR	jeg	(allerede)	fået	(Zero-quantification)
			No	points	HAVE	Ι	already	received	

(Stressing the complement of *ingen* indicates constituent negation: I didn't get any POINTS, but I got something else.)

Both English negative inversion and Danish *verum*-focus satisfy the revised version of the NEG-criterion by maximally marking the presence of NegP.

English seemingly poses a problem for the NEG-criterion because in English the object always follows the lexical verb which in turn always stays inside vP. The solution Haegeman (1995: 185) proposes is that English allows the insertion of an empty operator in spec-NegP which is co-indexed with the object in situ. In the revised version of the NEG-criterion proposed here, that solution is out because the **overt** marker, the one which is subject to the NEG-criterion, is below NegP. I propose that the NEG-criterion is a violable constraint and that it is violated in English. On the other hand, the EPP-feature on Neg^o which makes it possible to merge adverbials in the specifier of Neg^o must also be checked. Feature checking is not subject to violable constraints: uninterpretable features must be checked or the derivation crashes. Hence, a repair strategy must be applied. What I propose is that in English movement to spec-NegP is covert. That is, there is movement, not operator insertion.

The NEG-criterion is a *representational* constraint (or "filter"), not a *derivational* constraint, and hence, what is relevant for the NEG-criterion is the output representations, not the individual derivational steps. (For an overview on constraints in syntax, see Müller 2002.)

In the tree below, the adverbial phrase right-adjoined to *vP* may also be left-adjoined in English as adverbials may either precede or follow the main verb (in both cases they follow negation).



2.4.3 NEG-shift across verbs

The languages initially fall into three groups: Group 1 is the set of languages that allow NEGshift to apply across the main verb when it does not move to Fin^o or C^o. Neither Group 2 nor Group 3 allows this. In Group 2, string-vacuous NEG-shift is allowed but not NEG-shift across the main verb: When the main verb intervenes, *ingen* is substituted by *ikke...nogen*. Group 3 allows negative objects to be spelled out in situ. Group 1 will subsequently be divided into three sub-groups depending on the strategy applied when the intervener is a preposition.

2.4.3.1 Group 1: NEG-shift

As in Danish (see section 0), NEG-shift is obligatory in Faroese, Icelandic, Norwegian, and Swedish. As the following examples show, it takes place across the selecting main verb inside vP in sentences with auxiliary verbs:

```
(225)
         Da: a. *Vi har
                               da
                                                          [vP set ingen fugle ]
               b. Vi har
                                         ingen fugle<sub>1</sub> [_{vP} set t<sub>1</sub>
                                                                                    ]
                               da
                                                                                  (Hansen 1984: 58)
                    We have though no
                                                 birds
                                                               seen
(226)
         Ic: a. *Jón hefur
                                                    [vP lesið engar bækur ]
                    Jón hefur <u>engar bækur</u><sub>1</sub> [<sub>vP</sub> lesið t<sub>1</sub>
                                                                                ]
               b.
                                                                         (Rögnvaldsson 1987, (31))
                    Jón has
                                          books
                                  no
                                                        read
(227)
         Fa: a. *Eg havi
                                          [<sub>vP</sub> sæð <u>ong</u>an ]
               b. Eg havi ongan<sub>1</sub>
                                          [<sub>vP</sub> sæð t<sub>1</sub>
                                                           ]
                    I have nobody
                                                                              (Lockwood 2002: 125)
                                              seen
(228)
         No: a. *Studentene
                                      har
                                                                 [vp lest ingen romaner ]
                                                                                               ]
               b.
                    Studentene
                                             ingen romaner<sub>1</sub> [vP lest t<sub>1</sub>
                                      har
                    The.students have no
                                                     novels
                                                                     read
                                                                    (Christensen 1986: 1, (1) & (2))
(229)
         Sw: a. *Han hade
                                              [vp sett ingenting ]
               b. Han hade ingeting<sub>1</sub> [_{vP} sett t<sub>1</sub>
                                                                      ]
                    He
                         had nothing
                                                  seen
                                                                        (Platzack 1998: 134, (5:29))
```

In section 2.4.5 below, I argue that the same applies to Dutch and German.

2.4.3.2 Group 2: Neutralization

Recall from section 2.2.2 that some speakers of Danish finds overt NEG-shift stylistically marked as literary or formal. In Norwegian, according to Svenonius (2002: 2), NEG-shift in main clauses with compound tense is not possible in colloquial speech but it is found in literary or formal styles. According to Christensen (1986: 28) and Faarlund et al. (1997: 884), NEG-shift in compound tense is stylistically marked (Christensen 1987 makes no such distinction). According to Holmes & Hinchliffe (2003: 165, 478) overt NEG-shift is also

stylistically marked in Swedish. Thus, in (at least some varieties of) colloquial Danish, Norwegian, and Swedish, grouped together as Scan2, NEG-shift can only apply in clauses without auxiliary verbs, that is, string-vacuously. (I use Danish words in the Scan2 examples.)

(230)Scan2: a. Han læste_v ingen bøger₁ [$_{vP}$ t_v t₁] books He read no [vp læst ingen bøger] b. *Han har c. *Han har $\int_{vP} last t_1$ ingen bøger₁ 1 books Не has no read

(I disregard the difference in the markedness of NEG-shift in the three languages: No > Sw, Da.)

To remedy the impossibility of overt NEG-shift a repair strategy is applied: in compound tense, *ingen* is substituted for *ikke...nogen* and the optional choice between the two is **neutralized**. I shall therefore refer to this repair strategy as **lexical substitution** or **neutralization**.

Ingen 'no' and *ikke...nogen* 'not...any' have identical formal feature bundles: they mean the same thing. What they do not share is the phonological feature bundle: They do not sound the same:³²



The substitution process changes the phonological features and rearranges the formal feature bundles. Importantly, no additional formal or lexical features are added and none are deleted.

(Alternatively, all aspects of phonology, as well as phonetics, are handled in the phonological component after spell-out, in which case nothing is substituted, only rearranged or split up. Under this analysis, there is clearly no violation of the *Inclusiveness Condition*

³² Other examples include

⁽i) a. dette 'this' [Def, Neuter, Sing, Proximal] (formal)

b. det [Def, Neuter, Sing] her [Proximal] 'this here' (colloquial)

⁽ii) a. *hvilken* 'which' [Wh, Indef, Sing] (only in written text or formal speech)b. *hvad* [Wh] *for en* [Indef, Sing] 'what for one' (only in informal speech)

(Chomsky 1995: 225, 2001: 2) stating that lexical material and features that are not part of the lexical array constituting the input are inaccessible throughout the derivation.)

2.4.3.3 Group 3: Object in situ

In the third group, negative objects can license sentential negation in situ. Finland Swedish (a variant of Swedish spoken in Finland), unlike all the other Scandinavian languages, does not have NEG-shift. Instead of substituting *ingen* with *ikke...nogen*, *ingen* licenses sentential negation in situ (I shall argue that NEG-shift does not apply string-vacuously either):

```
(232) FS: a. Jag har [vP haft ingenting att skaffa med den saken]
b. *Jag har ingenting1 [vP haft t1 att skaffa med den saken]
I have nothing had to do with that case.the
(Bergroth 1917: 173, Hulthén 1947: 130)
```

In English the main verb never moves out of vP, regardless of the presence or absence of auxiliaries.³³ Sentential negation is licensed either by *not* or by the object in situ:

```
(233) En: a. Jack [vP received no letters]
    b. *Jack no letters1 [vP received t1 ]
(234) En: a. Jack has [vP received no letters]
    b. *Jack has no letters1 [vP received t1 ]
```

French also belongs to this group. Like all the Scandinavian languages and English, French has two ways of making a negative transitive clause with an indefinite object: either with the negative adverbial *pas* 'not' or with a negative quantifier. In both cases, at least in written and formal language, Neg^o is realized as n(e) (French has negative concord). The verb moves through Neg^o picking up *ne* on the way to Fin^o. As *pas* remains in spec-NegP, the order of the two elements is reversed.

(235) Fr: Pierre <u>n'a</u> pas voulu <u>de cadeaux</u>. Pierre NEG-has not wanted of presents "Pierre didn't want any presents." (Rowlett 1998:84, (63a))

³³ Possessive *have* may be an exception. In certain variations of English, it does not take *do*-insertion as in Standard English but moves to a position preceding negation: *I haven't any money* vs. *I don't have any money*.

Like English and Finland Swedish, French does not allow has NEG-shift across the verb (except with *rien*, see see example (129) in section 2.3.4 above):

(236) Fr: Je <u>n'</u>en ai trouvé <u>aucun</u>
*Je <u>n'</u>en ai <u>aucun</u> trouvé
I NEG-of.them have none found
"I haven't found any."
(based on Confais 1978: 135)

In fact, the repair strategy applied in this group is not to leave the object inside VP and NegP empty (in a non-phonological sense). Rather, to secure convergence at LF, the negative feature on Neg^o must be valuated and checked; likewise, the EPP-feature on Neg^o must be checked by filling spec-NegP (which is otherwise done by merging e.g. *not* or *never* showing that Neg^o does have an EPP-feature). In section 2.3.7, I argued that what happens is that the formal feature bundle moves covertly while the phonological features are stranded in situ, giving rise to what is, typologically speaking, an 'odd' surface string.

2.4.3.4 A Note on Embedded Clauses

In my analysis, I concentrate on main clauses. However, the corresponding examples with embedded clauses would be completely parallel. In Scandinavian (except Icelandic), the finite verb remains in v^{o} in embedded clauses, and NEG-shift will always have to apply across it.

In Scan2 (cf. section 2.4.3.2), NEG-shift cannot cross the verb and embedded clauses are always constructed with *ikke...nogen* 'not...any':

In the other Mainland Scandinavian languages and Faroese, NEG-shift applies across the verb:

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(239)	Da/Fa/No/Sw:	a.	 at	jeg	ingen	$bøger_1$	$[_{v\mathbb{P}}$	havde	læst	$t_1]$
			that	Ι	no	books		had	read	
		b.	 at	jeg	ingen	bøger ₁	[_{vP}		læste	t ₁]
			that	I	no	books			read	

Icelandic has 'V°-to-I°' movement, or rather, V°-to-Fin°: the finite verb always moves to Fin° above NegP. In compound tense, the pattern is parallel to that in main clauses: NEG-shift crosses the main verb but not the auxiliary. In non-compound tense, the main verb moves to Fin° and NEG-shift only crosses the trace of the verb:

(240) Ic: a. ... að ég hef_v <u>engar bækur</u>₁ [_{vP} t_v lesið t₁] *that I have no books read* b. ... að ég las_v <u>engar bækur</u>₁ [_{vP} t_v t₁] *that I read no books*

Finally, in Finland Swedish, English, and French NEG-shift never applies:

(241) FS: Som jag [vP hade ingen brådska], stannade jag kvar.
 As I had no hurry stayed I back
 "As I was in no hurry, I stayed where I was"

(Bergroth 1917: 173, Hulthén 1947: 130)

(242) En: a. ... that I did <u>not</u> $[v_P \text{ read } any \text{ books}]$ b. ... that I $[v_P \text{ read } no \text{ books }]$

(243) Fr: a. Puisque il ne connaissait personne, il est parti
b. *Puisque il ne personne connaissait , il est parti
As he NEG no one knew he has left
"As he didn't know anyone, he left."

Consider next what happens when the negative object is the complement of a preposition.

2.4.4 NEG-shift across Prepositions

When the object is the complement of a preposition, the languages differ a bit further and group 1 is split into three subgroups according to whether the languages have preposition stranding (group 1.a), pied-piping (group 1.b), or lexical substitution which leads to neutralization of optionality (group 1.c).³⁴

2.4.4.1 Group 1.a: Preposition stranding

In Faroese and Icelandic, the NEG-criterion is satisfied by preposition stranding. NEG-shift is allowed to apply across the licensing preposition and no alternative strategy is required:

(244)[vp talað **við** neinn] Ic: a. Jón hefur ekki Jón has not spoken to anyone b. *Jón hefur [vP talað **við** engan] c. Jón hefur $\underline{en}gan_1$ [vP talað **við** t₁] d. ?Jón hefur [**við** engan]₁ [$_{vP}$ talað t₁] Jón has spoken with no-one

(Thórhallur Eythórsson, p.c., Jónsson 1996: 83, (105))

(245)Fa: a. Eg havi ikki [vP tosað **við** nakran] Ι have not spoken with anyone b. *Eg havi [_{vP} tosað **við** ongan] c. Eg havi $[_{vP}$ tosað **við** t₁] $ongan_1$ d. *Eg havi [**við** ongan] $_1$ [$_{vP}$ tosað t $_1$] I have with no.one spoken

(Thráinsson et al. 2004: 246, (65), Zakaris Hansen, p.c.)

2.4.4.2 Group 1.b: Pied-piping

There seems to be a dialectal difference in the preferred repair strategy in Icelandic. According to Gunnar Hrafn Hrafnbjargarson and Jóhanna Barðdal (p.c.), pied piping is preferred. I refer to this dialect or variant as Icelandic2:

³⁴ Only subcategorized prepositions may be stranded, that is, preposition stranding is possible with object extraction whereas it is not possible with adjunct extraction.

(246)Ice2: a. Jón hefur ekki [_{vP} talað **við** neinn] Jón has not spoken to anyone b. *Jón hefur [vp talað við engan] c. ??Jón hefur $[_{vP}$ talað **við** t₁ <u>engan</u>1] d. Jón hefur [**við** $engan]_1 [_{vP} talað$ 1 t1 Jón has with no.one spoken

I shall argue in section 2.4.5 that Dutch and German also belong to this group.

2.4.4.3 Group 1.c: Neutralization

In Danish, Norwegian, and Swedish the NEG-criterion is satisfied by lexical substitution (neutralisation) of *ingen* 'no' by *ikke...nogen* 'not any':

(247)Jeg har ikke Da: a. $[v_{P} peget$ på nogen] pointed at anyone Ι have not b. *Jeg har [vp peget på ingen] c. *Jeg har $ingen_1$ [vp peget **på** t₁] Ι have no.one pointed at (248)No: a. Studentene leser <u>ikke</u> [$_{vP}$ om noen svenske forfattere] Students-the read not about any Swedish writers b. *Studentene leser $[v_{P} \text{ om }$ ingen s. f.] c. *Studentene leser [ingen s. f.]₁ [$_{vP}$ om] t_1 S. w. Students-the read no about (Christensen 1987: 6, (13) & (13)'; 4, (20)) (249) Sw: a. Han har inte [vp pratad **med** någon] talked with anyone He has not b. *Han har [vP pratad **med** ingen] c. *Han har $\underline{ingen_1}$ [vP pratad med] *He* has no.one talked with (cf. Holmes & Hinchliffe 2003: 165) Thus, unlike verbs, prepositions block NEG-shift which suggests that the constraint on object position that conflicts with the NEG-criterion is in fact two constraints: one on the order of verbs and objects and one on prepositions and their complements.

2.4.4.4 Group 2: Neutralization

Recall that, in Scan2, *ingen* is not possible in clauses with auxiliary verbs. In fact, as with Group 1.c, *ingen* is not possible as the complement of a preposition either and the choice between *ingen* and *ikke...nogen* is neutralized as only the latter is possible:

(250)Scan2: a. Han læste ikke $[v_{P} t_{v} \mathbf{i} nogen bøger]$ He read not in any books $[_{vP} t_v \mathbf{i} \text{ ingen bøger }]$ b. *Han læste in no Не read books c. *Han har [vP læst **i** ingen bøger] d. *Han har ingen bøger₁ [_{vP} læst **i** t₁] e. *Han har [i ingen bøger]₁ [_{vP} læst t₁] He has in no books read

2.4.4.5 Group 3: Object in situ

As might be expected, the languages in group 3, English, Finland Swedish, and French, allow neither preposition stranding nor pied-piping. In other words, NEG-shift never applies and the negative object remains in-situ. Note that this even applies to French *rien* which is the only French NegQP that undergoes NEG-shift across verbs, see (129) in section 2.3.4 above).

```
(251)
         En: a. John has
                                          [vP talked to no-one ]
              b. *John has no-one<sub>1</sub> [_{vP} talked to t<sub>1</sub>
                                                                    ]
(252)
         FS: a. Jag hittade<sub>v</sub>
                                                  [v_{P} t_{v} p \dot{a} ingenting]
              b. *Jag hittade, ingenting1 [vp t, på t1
                                                                           ]
                                    nothing
                         found
                    Т
                                                          on
                    "I didn't think of anything"
                                                       (Bergroth 1917: 174, Hulthén 1944: 124)
```

(253)Fr: a. Je n'ai [vP pensé **à** rien] b. *Je n'ai $rien_1$ $[_{vP}$ pensé **à** t₁] c. *Je n'ai [**à** rien]₁] $[v_{P} pensé t_1]$ (Confais 1978: 135) I NEG-have on nothing thought (254)Fr: Il n'a ... He NEG-has a. ... $[v_{P} \text{ parlé } \mathbf{d'} \text{ aucun de ses livres }]$ b. *... $[v_{P} parlé de t_1]$ aucun de ses livres] с. *... $[\mathbf{d'} \text{ aucun de ses livres}]_1 [_{vP} \text{ parlé t}_1]$] on none of his books talked "He didn't talk about any of his books."

2.4.5 Dutch & German: Focal vs. Non-focal Negation

In Dutch and German, like in all the Scandinavian languages, NEG-shift is string-vacuous in non-compound tense (Dutch data due to Peter Bakker, p.c.): ³⁵

(255) Du: Zij las_v <u>geen boeken</u>₁ [_{vP} t₁ t_v] She read no books
(256) Ge: Sie las_v <u>keine Bücher</u>₁ [_{vP} t₁ t_v] She read no books

In compound tense, Dutch and German raise the question whether NEG-shift crosses the main verb or not because they are OV languages.

(257) Du: Zij heeft <u>geen boeken</u>₁ [vP t₁ gelezen] She has no books read
(258) Ge: Sie hat <u>keine Bücher</u>₁ [vP t₁ gelesen]. She has no books read

Whether both vP and VP are head final or the participial verb does not move to v° is theoryinternal: the difference is string-vacuous as the non-finite main verb always follows both the indirect and the direct object:

³⁵ In Dutch, the non-compound past form seems to need a follow-up, such as "...but she did read some newspapers". To construct the past tense, the compound form is preferred.



The important thing is that VP is head-final, cf. Vikner (2001*b*: 17). I will assume the head-first *v*P and head-final VP structure in (259)b.

The question is then what the relevant measure is for whether object movement crosses the verb or not: precedence or c-command. If precedence is the determining factor (that is, ccommand asymmetric) then NEG-shift does not cross the verb as both the base-position of the object and spec-NegP linearly precede V^o:

(260) Linear Correspondence Axiom

A category α precedes a category β if and only if

- (a) α asymmetrically c-commands β , or
- (b) γ precedes β and γ dominates α .

(Uriagereka 1998: 200; see also Kayne 1994)

On the other hand, as I shall assume, if structure is the determining factor (that is, c-command is symmetric), Dutch and German pattern like the Scandinavian languages (except Scan2) in allowing NEG-shift to apply across the main verb, but with the difference that NEG-shift is string-vacuous both with and without auxiliary verbs (because VPs are head-final the finite auxiliary is in V2 position in main clauses and sentence-final in embedded clauses).

When the NEGQP is the complement of a preposition, Dutch and German pattern with Ice2, and hence, belongs to group 1.b, in having pied piping instead of preposition stranding (preposition phrases are, as the name implies, head-first and therefore movement across P^o is not string-vacuous):

(261) Du: a. *Zij heeft geen boeken₁ [vP [PP in t₁] gelezen]. b. Zij heeft [PP in geen boeken]₁ [vP t₁ gelezen]. She has in no books read "She hasn't read in any books."

The Dutch *een paar* and the German *einige* cannot be used as NPIs. They are incompatible with a sentential NegP and cannot mean 'any'. Thus, *niet een paar* and *nicht einige* can never substitute for *geen* and *keine* or vice versa:

(264)	Ge:	a.	*Sie	hat			nicht	einige	Bücher	gelesen.
		b.	*Sie	hat	einige	Bücher	<u>nicht</u>			gelesen.
			She	has	some	books	not			read
Intended meaning: "She hasn't read any books.							oks."	(=(258), ¬∃)		

The b examples are fully grammatical with the meaning 'some not' $(\exists \neg)$ (*there are some books for which it is not the case that she has read them*). This, however, is not the intended meaning, which was the 'not any' $(\neg \exists)$ reading where negation scopes over the existential quantifier (*it is not the case that there are any books such that she has read them*). This is not the case with *geen* and *keine*:

(265) Du: a. Zij heeft <u>niet een paar boeken</u> gelezen, maar een paar kranten. She has not some books read but some newspapers

b. *Zij heeft <u>geen boeken</u> gelezen, maar een paar kranten.
She has no books read but some newspapers
Intended: "She didn't read some books but she did read some newspapers." (¬∃)

(266) Du: a. Zij heeft <u>een paar boeken</u> <u>niet</u> gelezen, mar ik ga ze wel lezen. She has some books not read but I go them will read

b. *Zij heeft geen boeken gelezen, mar ik ga ze wel lezen.
She has no books read but I go them will read
Intended: "There are some books she didn't read, but I'm going to read them." (∃¬)

- (267) Ge: a. Sie hat <u>nicht einige Bücher</u> gelesen, sondern einige Zeitungen. She has not some books read but some newspapers
 - b. *Sie hat keine Bücher gelesen, sondern einige Zeitungen.
 She has no books read but some newspapers
 Intended: "She didn't read some books, but she did read some newspapers." (¬∃)
- (268) Ge: a. Sie hat <u>einige Bücher</u> <u>nicht</u> gelesen, aber ich werde sie lesen. She has some books not read but I will them read
 - b. *Sie hat keine Bücher gelesen, aber ich werde sie lesen.
 She has no books read but I will them read
 Intended: "There are some books she didn't read, but I'm going to read them." (∃¬)

There are (at least) two different possible analyses of the differences in scope and distribution between *nicht* and *kein*: a difference in formal feature composition or a difference in structural position.

The first solution is to assume that the difference between the two negative operators is that *niet/nicht* is a **syntactic focus** operator while *geen/kein* is not. *Geen/kein* is compatible with **phonological focus**, i.e. stress (for a different analysis of German negation, see Kappus 2000):

```
    (269) a. Du: niet [Neg, Foc] focal negation
    Ge: nicht
    b. Du: geen [Neg] sentential negation
    Ge: kein
```

The scope of *niet/nicht* is determined by long-distance agreement in focus with VP, such that only what is inside VP is negated. This hypothesis fits well with Diesing's (1997) *Mapping Hypothesis* about how syntactic structure maps into LF representations:

(270) The Mapping Hypothesis

- a. VP maps into the Nuclear Scope (the domain of existential closure)
- b. IP maps into the restriction (of an operator) (Diesing 1997: 373, (5))



I shall not go into further detail, but is seems that a more refined model is needed because Neg-operators and quantifiers do not move to CP: Neg-operators move to spec-NegP and quantifiers move to the edge of vP in order to be available for long-distance agreement with Fin^o. However, the important thing is that the VP-domain is the domain for new information, and if possible, elements that are old information move out of vP, such as e.g. the topic. (See Kaiser, in press, for similar arguments for Finnish.)

For this analysis to work, the topmost projection in the VP-domain must have a [+Foc] feature (which may have percolated from v°); *niet/nicht* is merged on top of vP and has an unvalued focus feature [*u*Foc] which is deleted under feature matching. *Geen/kein*, on the other hand, does not have a [*u*Foc] feature and is therefore not a probe that can agree with the VP-domain in focus/scope. *Geen/kein* takes clausal scope by default (because the domain of Neg^o is TP).

Another way of capturing the difference between *niet/nicht* and *geen/kein* is to assume that the base-position of the negative adverbial operator is below spec-NegP, as proposed in section 2.3.11 where negation is merged as an adjunct of vP and attracted by Neg^o under feature matching in order to check EPP, the same way as with negative objects. What needs to be explained is, then, why *niet/nicht* is not attracted to spec-NegP. A possible answer is that *niet/nicht* is actually merged even lower than the negative adverb in the Scandinavian languages (as suggested to me by Hubert Haider). If *niet/nicht* is merged inside the domain of v^{o} , say, to VP, it won't be available to operations outside vP which means that the derivation of a structure with a NegP in the IP-domain and *niet/nicht* in v' will always crash: *niet/nicht* can not escape the vP phase.



Importantly, this analysis is also compatible with the Mapping Hypothesis in (271) and therefore also captures the intuition that *niet/nicht* is a focus negator and thus always has narrow scope.

2.4.6 Finnish & Hebrew: No NegQP

In the previous section, I presented evidence showing that Dutch and German do not have a version of the NegAdvP *not* with sentential scope. In this section I present the mirror image, no NegQP, only NegAdvP, as found in Finish and Hebrew which go together as group 4.

In Finnish, a negative clause with and indefinite object is always derived with (a version of) *ei* 'not' (see chapter 3, section 3.3.5.2). "Finnish has no negative quantifiers. Instead, negative polarity items are used with negation, as shown below, as well as negatively-oriented adverbs such as *tuskin* 'hardly'" (Kaiser, in press: 5).

(273) Fi. Liisa ei ostanut mitään. Liisa-NOM NEG.3SG bought anything-PART.
"Liisa bought nothing ~ Liisa didn't buy anything." (Kaiser, in press: 5, (3e))

Shlonsky (1997: 60) argues that Hebrew *?eyn* 'not', like French *ne* and Finnish *ei*, is the overt realization of Neg^o. Note that it agrees with the preceding subject in number and gender:

Negative indefinites are also constructed with *?eyn* but without a quantifier:

```
(275) He: ?eyn ha-ylad-im ba-gina
NEG the-child-PLUR in.the-garden
"There are no children in the garden." (Shlonsky 1997: 82, (5-1.b))
```

The variation in negation marker is summed up in the following diagram (leaving aside details of XP/X° status of the non-quantified negation marker, here labelled NegAdv(P)):





In the analysis below I leave out Finnish and Hebrew as the analysis is primarily concerned with the negative quantifiers and NEG-shift.

2.4.7 Parametric Variation: A Typology of NEG-shift

The table below is a summary of the languages discussed and the various repair strategies applied in these languages to circumvent potential blocking effects on NEG-shift by the licensing verb or preposition.

(277)**NEG-shift**:

Group	Language		Overt NEG-shift									
		$across t_{\nu}$ $across Verb$ $across Preposition$										
1.a	Fa, Ic	\checkmark	 ✓ 	✓ Stranding	Free							
1.b	Du, Ge, Ice2	\checkmark	\checkmark	* Pied piping								
1.c	Da, No, Sw	✓	\checkmark	✗ Neutralization								
2	Scan2	\checkmark	✗ Neutralization	✗ Neutralization								
3	En, Fr, FS	× Obj in situ	≭ Obj in situ	≭ Obj in situ	Blocked							
4	Fi, He	Not applicable										

(278)A typology of NEG-shift:



As NEG-shift is object movement (at least the cases discussed here, but see section 2.4.10 below), the question arises whether Holmberg's (1986: 165) famous generalisation on object shift is respected or not (repeated from (120) above):

(279)Holmberg's Generalisation (HG)

Object shift cannot move across the surface position of its case assigner and is therefore dependent on verb movement.

In fact, the languages fall into three classes: in the diagram in (278), the language groups under the parameter '-NEG-shift across V' (group 2 and 3), respect it completely (group 3

respect it vacuously): NEG-shift never crosses the licensor of the object; those under '–NEG-shift across P' (group 1.a and 1.c) respect it partially, that is, only with verbs; finally, group 1.a violates it completely: neither verbs nor prepositions block NEG-shift.

(Group 1.b and group 3 could logically speaking be split into "pied piping" and "in situ" (+ and –pied piping, respectively), but for both groups there are good reasons not to adopt such a branching. For group 1.b, it is very unlikely that a language would allow NEG-shift across the verb while having object in situ with prepositions. In the former, EPP is checked overtly on Neg^o, while it would have to be checked covertly in the latter case, which would be very odd. For (3) it would be theory-internal. The possibility disregarded here is +pied-piping (Group 3 above is –pied-piping), that the verb can be pied-piped. It would have to be argued that the feature of the NegQP object in situ could percolate to vP which in turn moves to spec-NegP (like in a roll-up system, cf. Kayne 1998). This vP movement would be string-vacuous, unless it could be shown that there exists a language where floating quantifiers in spec-TP and/or some overt free morpheme in T^o follow the verb and the NegQP while preceding them in positive contexts.)

2.4.8 Optimality Theory Analysis

2.4.8.1 Constraints

The variation in NEG-shift can be accounted for by different rankings of six universal and violable constraints.

NEGCRIT is a constraint requiring that the scope of negation has, with a term borrowed from Gärtner (2004, 2005), *Unambiguous Encoding*: Sentential negation must be overtly marked (see section 2.4.2 above):

(280) NEGCRIT

NegP must be (maximally) overtly marked.

There are two c-command requirements on the licensing of object positions: one on complements of verbs, V-LICENSE, and one on complements of prepositions, P-LICENSE.

(281) V-LICENSE (V-LIC)

An object must be licensed under c-command by either its selecting V° or the trace of this V° (Vikner's 2001*a*: 328 LICENSING).

(282) **P-LICENSE (P-LIC)**

An object must be licensed under c-command by either its selecting P^o or the trace of this P^o (a subcase of Vikner's 2001*a*: 328 LICENSING). "No preposition stranding"

The role of these licensing constraints is to preserve the 'underlying' structural relations throughout the derivation. In other words, they belong to the family of constraints requiring *Structure Preservation* or *Shape Conservation* (cf. Müller 2000: 6, 2001: 1; see also chapter 1, section 1.2.3).

To account for the neutralization of optionality in the use of *ingen* 'no' and *ikke...nogen* 'not...any', I propose a constraint on the correspondence between the elements in the lexical array / numeration and the output representation stating that they must be identical. This constraint is violated when *ingen* in the input is substituted with / realized as *ikke...nogen*.

(283) **IDENTIO (ID)**

The output elements (lexical material) must be identical to the input elements "No substitution"

(This constraint is a syntactic version of the phonological correspondence constraint IDENT-IO[F]: 'no featural changes', Kager 1999:250, (135).)

Assuming the theory proposed in *Derivation by Phase* (Chomsky 2001), probes and matching goals enter into long-distance agreement and phrasal movement only takes place if the probe also has an EPP-feature which allows it to take a specifier (see section 2.3). EPP-features are nominal features and for a PP to check it, the nominal features of the DP selected by P^o must percolate to PP. This is illustrated in (284) below. The first dotted arrow, from D^o to DP is not percolation. DP has the same feature composition as the projecting D^o. The second dotted arrow, on the other hand, is percolation. The containing PP inherits the nominal [+N] feature by percolation from DP:



The constraint needed is one that punishes such feature percolation and, hence, pied-piping:³⁶

(285) ***PERCOLATION (*PERC)**

No feature percolation / "No pied piping"

Finally, a general constraint on movement or economy of derivation, stating that movement should be avoided:

(286) Stay

Economy of derivation / "Do not Move"

(In the tableaux below, only violations of STAY caused by NEG-shift are indicated.)

I assume the input to consist of a lexical array (LA) plus a logical form (LF). In all the tableaux below, the input contains a version of *ingen/no*. When the input contains *ikke/not*, the 'faithful' candidates, i.e. (a1), (b1), (c1), and (d1), are always optimal as they violate neither IDENTIO nor any of the other constraints.

2.4.8.2 Group 1.a: Faroese and Icelandic

First of all, Faroese and Icelandic allow NEG-shift to cross the main verb. That shows that the NEG-criterion (NEGCRIT) and the requirement that the lexical elements in the input surface in the output (ID, "no substitutions") have priority over the requirement that verbs c-command their objects (V-LIC). Also, economy of derivation (STAY, "do not move") must be ranked low to allow the object to move in the first place. That means that the first four constraints are ranked as follows (The relative ranking between NEGCRIT and ID is not crucial nor is the one between V-LIC and STAY):

(287) Group 1.a: {NEGCRIT, ID} » {V-LIC, STAY}

In the tableau in (289) below, the (a) competition is between candidates ((a1), (a2), and (a3)) in clauses with an auxiliary verb in V2 position (S=Subject, Aux=Auxiliary, V=main verb). As indicated with the pointing hand (\mathbb{R}), the candidate with overt NEG-shift, i.e. candidate

³⁶ Heck (2001) has argued for an analysis of pied piping along the same lines and *PERCOLATION and P-LICENSE are (more or less) equivalent to his LOCALITY CONDITION ON CHECKING and PP-ISLAND, respectively.

(a3), is optimal as it does not violate NEGCRIT or ID which are violated by its competitors. The violations of V-LIC and STAY are irrelevant (as indicated with shading).

Second, Faroese and Icelandic allows NEG-shift to apply across prepositions as well. This shows that P-LIC ("no preposition stranding"), the requirement that prepositions c-command their complements, is ranked lower than NEGCRIT and ID or *enginn* would be substituted with *ekki...neinn*. Furthermore, P-LIC is ranked lower than *PERC ("no percolation/pied piping") or the preposition would be pied-piped and move with the object to spec-NegP.

(288) Group 1.a: {NEGCRIT, ID, *PERC} » P-LIC

In the tableaux below, competitions (a) and (b) are about NEG-shift across verbs, (c) and (d) are about NEG-shift across prepositions. The candidates in competitions (a) and (c) have auxiliary verbs in V2, while the candidates in competitions (b) and (d) have the main verb in V2 and no auxiliaries. An asterisk (*) indicates a candidate is ungrammatical, a pointing hand (\mathbb{R}) that it is optimal.

	NEG-shift across verbs Input: <i>enginn</i>		Neg Crit	ID	*PERC	P- Lic	V- Lic	St AY
a1 * a2 ☞ a3	$\begin{array}{c c} S & Aux & [_{NegP} ekki & [_{\nu P} V \\ \hline S & Aux & [_{NegP} & [_{\nu P} V \\ \hline S & Aux & [_{NegP} enginn & [_{\nu P} V \\ \end{array}$	<i>neinn</i>]] <i>enginn</i>]] t]]	*!	*!			*	*
b1 * b2 ☞ b3	$ \begin{array}{c c} S \ V & [_{NegP} \ ekki & [_{\nu P} \ t_{\nu} \\ \hline S \ V & [_{NegP} \ enginn & [_{\nu P} \ t_{\nu} \\ \hline S \ V & [_{NegP} \ enginn & [_{\nu P} \ t_{\nu} \\ \hline \end{array} \end{array} $	neinn]] enginn]] t]]	*!	*!				*
	NEG-shift across preposition Input: <i>enginn</i>	ns	Neg Crit	Id	*PERC	P- Lic	V- Lic	St Ay
c1 * c2 ☞ c3 * c4	S Aux $[NegP ekki$ $[\nu P V]$ S Aux $[NegP]$ $[\nu P V]$ S Aux $[NegP engri$ $[\nu P V]$ S Aux $[NegP P engri$ $[\nu P V]$	[PP P neinni]]] [PP P engri]]] [PP P t]]] [PP t]]]	*!	*!	*1	*	*	*
d1 * d2	$\begin{array}{c c} S V & [NegP \ ekki & [vP \ t_v \\ S V & [NegP \ ekki & [vP \ t_v \\ S V & [NegP \ engri & [vP \ t_v \\ \end{array} \\ \end{array}$	[PP P neinni]]] [PP P engri]]] [PP P t]]]	*!	*!	<u>.</u>	*		*
l ⊷ an	I S V LNegr Chight LvP w							

(289) Tableau 1: Group 1.a (Fa, Ic)

In short, there is no need for repair strategies in Faroese and Icelandic as NEG-shift is allowed to apply freely across both verbs and prepositions.
2.4.8.3 Group 1.b: Dutch, German, and Icelandic2

As in group 1.a, NEG-shift is free to apply across the verb and no alternative strategy is required. The relevant ranking is therefore the same as the one in (287) above and the (a) and (b) competitions are identical (candidate (a3) wins in all of them):

(290) Group 1.b: {NEGCRIT, ID} » {V-LIC, STAY}

The difference between group 1.a and 1.b is the licensing of NEG-shift across prepositions which is allowed in the former but blocked in the latter. To satisfy the NEG-criterion, group 1.b has pied piping. The fact that NEG-shift takes place in some form across prepositions in the first place shows that ID ("no substitutions") is respected.

(291) Group 1.b: {NEGCRIT, P-LIC, ID} » *PERC

	NEG-shift across ver Input: <i>enginn</i>	bs	NEG Crit	P- Lic	Id	*PERC	V- Lic	St Ay
a1 * a2	S Aux [NegP ekki	$[_{vP} V neinn]]$	*1	-	*!		-	
™ a3	S Aux [NegP enginn	$\begin{bmatrix} v_{P} V t \end{bmatrix}$					*	*
b1	S V [_{NegP} ekki	$\begin{bmatrix} v_{P} t_{v} neinn \end{bmatrix}$			*!			
* b2	SV [NegP	$[v_{P} t_{v} enginn]$	*!					
r≊ b3	S V [NegP enginn	$\begin{bmatrix} vP t_v t \end{bmatrix}$						*
	NEG-shift across pre	positions	NEG	Р-	Id	*Perc	V-	St
	Innut enginn		Com	T to			-	
	mput. enginn		CRIT	LIC			LIC	AY
c1	S Aux [_{NegP} ekki	$[_{\nu P} V [_{PP} P neinni]]]$	CRIT	LIC	*!		LIC	AY
c1 * c2	S Aux [_{NegP} ekki S Aux [_{NegP}	$\begin{bmatrix} v_{P} V [p_{P} P neinni]] \\ v_{P} V [p_{P} P engri]] \end{bmatrix}$	*!	LIC	*!		LIC	AY
c1 * c2 * c3	S Aux [NegP ekki S Aux [NegP S Aux [NegP engri	$ \begin{bmatrix} v_{P} V [p_{P} P neinni]] \\ v_{P} V [p_{P} P engri]] \\ v_{P} V [p_{P} P t]] \end{bmatrix} $	*!	*!	*!		LIC	AY *
c1 * c2 * c3 ™ c4	S Aux [NegP ekki S Aux [NegP S Aux [NegP engri S Aux [NegP P engri	$ \begin{bmatrix} v_{P} V & P_{P} P neinni \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P engri \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P t \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P t \end{bmatrix} \end{bmatrix} $	*!	*!	*!	*	LIC *	AY *
c1 * c2 * c3 ☞ c4 d1	S Aux [NegP ekki S Aux [NegP S Aux [NegP engri S Aux [NegP P engri S V [NegP ekki	$ \begin{bmatrix} v_{P} V & P_{PP} P neinni \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{PP} P engri \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{PP} P t \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{PP} t \end{bmatrix} \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{PP} t \end{bmatrix} \end{bmatrix} $	*!	*!	*!	*	*	AY * *
c1 * c2 * c3 ☞ c4 d1 * d2	S Aux [NegP ekki S Aux [NegP S Aux [NegP engri S Aux [NegP P engri S V [NegP ekki S V [NegP	$ \begin{bmatrix} v_{P} V & P_{P} P neinni \\ v_{P} V & P_{P} P engri \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P t \\ v_{P} V & P_{P} P t \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} t \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P neinni \\ v_{P} t_{v} & P_{P} P neinni \end{bmatrix} \\ \begin{bmatrix} v_{P} t_{v} & P_{P} P engri \end{bmatrix} $	*!	*!	*!	*	*	AY * *
c1 * c2 * c3 * c3 * c4 d1 * d2 * d3	$\begin{tabular}{l l l l l l l l l l l l l l l l l l l $	$ \begin{bmatrix} v_{P} V & P_{P} P neinni \\ v_{P} V & P_{P} P engri \\ \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P t \\ v_{P} V & P_{P} P t \end{bmatrix} \\ \begin{bmatrix} v_{P} V & P_{P} P t \\ v_{P} v & P_{P} P neinni \\ \end{bmatrix} \\ \begin{bmatrix} v_{P} t_{v} & P_{P} P engri \\ v_{P} t_{v} & P_{P} P t \end{bmatrix} \end{bmatrix} $	*! *!	*!	*!	*	*	AY * *

(292) Tableau 2: Group 1.b (Du, Ge, Ice2)

In Dutch and German, all the candidates with *niet/nicht* 'not', i.e. candidates (a1), (b1), (c1), and (d1), are ungrammatical with sentential scope, cf. section 2.4.5. The candidates are only relevant for Icelandic2.

In short, the difference between Group 1.a and 1.b is the relative priority given to P-LIC ('objects must be c-command by their licensing prepositions', "no preposition stranding") in the two groups. In Group 1.a it is ranked lower than *PERC ("no percolation/pied piping"), while it is ranked higher in group 1.b where pied piping is preferred over stranding. Thus, the difference can be summed up as a promotion of P-LIC in Group 1.b (and shifting the » marker one place to the left):



2.4.8.4 Group 1.c: Danish, Norwegian, and Swedish

As was the case with Faroese and Icelandic (group 1.a) and Icelandic2, Dutch, and German (group 1.b), NEG-shift applies across the verb in group 1.c: Danish, Norwegian, and Swedish. That means that there is no difference in the ranking if the relevant constraints:

(294) Group 1.c: {NEGCRIT, ID} » {V-LIC, STAY}

As before, the crucial difference is related to NEG-shift across prepositions. Group 1.a has stranding and group 1.b has pied piping. Group 1.c, on the other hand, does not allow NEG-shift to apply to complements of prepositions. Instead, in order to satisfy the NEG-criterion (NEGCRIT), *ingen* is substituted with *ikke...nogen* in violation of ID, which must be ranked lower than P-LIC ("no preposition stranding"), and *PERC ("no percolation/pied piping"): barring pied piping and stranding is more important than keeping the lexical material constant. The relative ranking between NEGCRIT, P-LIC, and *PERC is not relevant as the optimal candidates ((c1) with auxiliaries and (d1) with the main verb in V2) violate none of them.

(295) Group 1.c: {NEGCRIT, P-LIC, *PERC} » IDENTIO

	NEG-shift across ver Input: <i>ingen</i>	bs	NEG Crit	P- Lic	*Perc	ID	V- Lic	St Ay
a1 * a2 ™ a3	S Aux [_{NegP} ikke S Aux [_{NegP} S Aux [_{NegP} ingen	$\begin{bmatrix} v_{P} V nogen \\ v_{P} V ingen \end{bmatrix}$ $\begin{bmatrix} v_{P} V t \\ v_{P} V t \end{bmatrix}$	*!			*!	*	*
b1 * b2 ☞ b3	S V [NegP ikke S V [NegP S V [NegP ingen	$ \begin{bmatrix} v_{P} t_{v} nogen \\ v_{P} t_{v} ingen \end{bmatrix} $ $ \begin{bmatrix} v_{P} t_{v} t_{v} t \end{bmatrix} $	*!			*!		*
	NEG-shift across pre Input: <i>ingen</i>	positions	Neg Crit	P- Lic	*Perc	ID	V- Lic	St ay
■ c1 * c2 * c3 * c4	S Aux [_{NegP} ikke S Aux [_{NegP} S Aux [_{NegP} ingen S Aux [_{NegP} P ingen	$ \begin{bmatrix} {}_{\nu P} V [{}_{PP} P nogen] \end{bmatrix} \\ \begin{bmatrix} {}_{\nu P} V [{}_{PP} P ingen] \end{bmatrix} \\ \begin{bmatrix} {}_{\nu P} V [{}_{PP} P t] \end{bmatrix} \\ \begin{bmatrix} {}_{\nu P} V [{}_{PP} P t] \end{bmatrix} \end{bmatrix} $	*!	*!	*!	*	*	*
■ d1 * d2	S V [NegP ikke	$\begin{bmatrix} v_{P} t_{v} [P_{P} P nogen] \end{bmatrix}$	*1			*		
$^{*} d3$	SV [NegP ingen SV [NegP ingen	$\begin{bmatrix} v_{P} & v_{V} & P_{P} & P_{P} & mgen \\ v_{P} & t_{v} & p_{P} & P & \\ \end{bmatrix} \begin{bmatrix} v_{P} & t_{v} & p_{P} & P & \\ p_{P} & t_{v} & p_{P} & t_{v} \end{bmatrix} \end{bmatrix}$		*!	*1			*

(296) Tableau 3: Da, No, Sw

As before, the difference in repair strategy can be accounted for by the reranking of a single constraint. The difference between group 1.b to 1.c is the relative ranking of *PERC:

(297)	Group 1.b	NEGCRIT,	P-LIC		» Id »	*Perc,	V-Lic,	Stay
	Group 1.c	NEGCRIT,	P-Lic,	*PERC	» Id »		V-Lic,	STAY

2.4.8.5 Group 2: Scan2 (colloquial Danish, Norwegian, Swedish)

What distinguishes Scan2 from the other Scandinavian languages is that NEG-shift can not apply across the verb and to satisfy NEGCRIT and instead lexical substitution is applied. V-LIC is ranked above ID which in turn outranks STAY. In other words, it's more important to keep objects inside the c-command domain of the selecting verb than to make sure that the lexical material in the input surfaces unchanged in the output.

(298) Group 2: {NEGCRIT, V-LIC} » ID » STAY

In Scan2, NEG-shift is subject to Holmberg's Generalization (cf. 2.4.7 above), and hence, it can not apply across a preposition either. In Scan2, the repair strategy is lexical substitution,

not pied-piping or stranding, and therefore, P-LIC and *PERC both outrank ID (the relative ranking between the two is not crucial):

(299) Group 2: {NEGCRIT, P-LIC, *PERC} » ID

	NEG-shift across ver	bs	NEG	P-	*Perc	V-	ID	ST
	Input: <i>ingen</i>		CRIT	LIC		LIC		AY
is al	S Aux [_{NegP} ikke	$[_{vP} V nogen]]$					*	
* a2	S Aux [NegP	$[_{vP} V ingen]]$	*!					
* a3	S Aux [NegP ingen	[_{vP} V t]]				*!		*
b1	S V [_{NegP} ikke	$[_{vP} t_v nogen]]$					*!	
* b2	SV [NegP	$[_{vP} t_v ingen]]$	*!					
IS b3	S V [_{NegP} ingen	$\begin{bmatrix} v_{P} t_{v} t \end{bmatrix}$						*
	NEG-shift across pre	positions	NEG	Р-	*Perc	V-	ID	ST
1	r	0000000	1,50	-	1 Brite	•		~ 1
	Input: <i>ingen</i>		CRIT	LIC	T Dire	LIC	12	AY
rs c1	Input: <i>ingen</i> S Aux [_{NegP} <i>ikke</i>	[_{vP} V [_{PP} P nogen]]]	CRIT	Lic		Lic	*	AY
r≊ c1 * c2	Input: <i>ingen</i> S Aux [NegP <i>ikke</i> S Aux [NegP	$[v_{P} V [p_{P} P nogen]]]$ $[v_{P} V [p_{P} P ingen]]]$	CRIT	Lic		Lic	*	AY
© c1 * c2 * c3	Input: <i>ingen</i> S Aux [_{NegP} <i>ikke</i> S Aux [_{NegP} S Aux [_{NegP} <i>ingen</i>	$[_{\nu P} V [_{PP} P nogen]]]$ $[_{\nu P} V [_{PP} P ingen]]]$ $[_{\nu P} V [_{PP} P t]]]$	CRIT	LIC *!		LIC	*	AY *
© c1 * c2 * c3 * c4	Input: <i>ingen</i> S Aux [_{NegP} <i>ikke</i> S Aux [_{NegP} S Aux [_{NegP} <i>ingen</i> S Aux [_{NegP} P <i>ingen</i>		CRIT *!	LIC *!	*!	LIC *	*	AY *
■ c1 * c2 * c3 * c4	Input: <i>ingen</i> S Aux [_{NegP} <i>ikke</i> S Aux [_{NegP} S Aux [_{NegP} <i>ingen</i> S Aux [_{NegP} <i>P ingen</i> S V [_{NegP} <i>ikke</i>	$ \begin{bmatrix} v_{P} V [P_{P} P nogen]] \\ v_{P} V [P_{P} P ingen]] \\ v_{P} V [P_{P} P t]] \\ v_{P} V [P_{P} P t]] \\ v_{P} V [P_{P} t]] \\ v_{P} V [P_{P} P nogen]] \end{bmatrix} $	*!	LIC *!	*!	LIC *	*	AY * *
■ c1 * c2 * c3 * c4 ■ c4 ■ c4 ■ c4 ■ c4	Input: <i>ingen</i> S Aux [_{NegP} <i>ikke</i> S Aux [_{NegP} S Aux [_{NegP} <i>ingen</i> S Aux [_{NegP} <i>P ingen</i> S V [_{NegP} <i>ikke</i> S V [_{NegP}	$ \begin{bmatrix} _{\nu P} V [_{PP} P nogen]] \\ _{\nu P} V [_{PP} P ingen]] \\ _{\nu P} V [_{PP} P t]] \\ _{\nu P} V [_{PP} P t]] \\ _{\nu P} V [_{PP} t]] \\ \\ _{\nu P} t_{\nu} [_{PP} P nogen]] \\ _{\nu P} t_{\nu} [_{PP} P ingen]]] $	CRIT *! *!	<u>Lic</u> *!	*!	*	*	AY * *
IST c1 * c2 * c3 * c4 IST d1 * d2 * d3	Input: <i>ingen</i> S Aux [NegP <i>ikke</i> S Aux [NegP S Aux [NegP <i>ingen</i> S Aux [NegP <i>P ingen</i> S V [NegP <i>ikke</i> S V [NegP S V [NegP <i>ingen</i>	$ \begin{bmatrix} v_{P} V [P_{P} P nogen]] \\ v_{P} V [P_{P} P ingen]] \\ v_{P} V [P_{P} P t]] \\ v_{P} V [P_{P} P t]] \\ v_{P} V [P_{P} t]] \\ v_{P} t_{v} [P_{P} P nogen]] \\ v_{P} t_{v} [P_{P} P ingen]] \\ v_{P} t_{v} [P_{P} P t]] \\ \end{bmatrix} $	CRIT *! *!	*!	*!	*	*	AY * *

(300) Tableau 4: Scan2

Compared with the parameters for Danish, Norwegian, and Swedish, Scan2 differs by one setting: NEG-shift cannot cross the verb and the repair strategy is lexical substitution (none of them allows NEG-shift across prepositions). V-LIC is promoted to outrank ID, which in turn is ranked above STAY allowing NEG-shift to cross the trace of the verb instead of allowing lexical substitution, compare candidates (b1) and (b3).



2.4.8.6 Group 3: English, Finland Swedish, and French

The languages in group 3, English, Finland Swedish, and French, do not allow NEG-shift across either verbs or presposition. The repair strategy is neither pied-piping, preposition

stranding, nor lexical substitution: negative objects can license sentential negation in situ. In other words, the NEG-criterion has the lowest priority among all the constraints relevant here:

(302) Group 3: {P-Lic, *Perc, V-Lic, ID, Stay} » NegCrit

It's more important to keep the object in the domain of the licensing head (verb or preposition), to maintain the lexical input in the output, and to avoid feature percolation, than to satisfy the NEG-criterion and unambiguously encode the structural position and scope of negation.

	NEG-shift across ve	rbs		P-	*Perc	V-	Id	ST	NEG
	Input: no/ingen/auci	in		LIC		LIC		AY	CRIT
al	S Aux [NegP not	$[_{\nu P} V any]]$					*!		
rs a2	S Aux [_{NegP}	$[_{\nu P} V no]]$							*
* a3	S Aux [NegP ingen	[_{vP} V t]]				*!		*	
b1	S V [NegP not	$\begin{bmatrix} v_{\rm P} t_v any \end{bmatrix}$					*!		
rs b2	S V [NegP	$[_{vP} t_v no]]$							*
* b3	SV [_{NegP} no	$\begin{bmatrix} v_{\rm P} t_v t \end{bmatrix}$						*!	
	NEG-shift across pro	epositions		P-	*Perc	V-	ID	St	NEG
	Input: no/ingen/auci	in		LIC		LIC		AY	Crit
c1	S Aux [NegP not	$[_{\nu P} V [_{PP} P any$]]]				*!		
rs c2	S Aux [NegP	[_{vP} V [_{PP} P no]]]						*
* c3	S Aux [NegP no	[_{vP} V [_{PP} P t]]]	*!				*	
* c4	S Aux [NegP P no	[_{vP} V [_{PP} t]]]		*!	*		*	
d1	S V [NegP not	$[_{\nu P} t_{\nu} [_{PP} P any$]]]				*!		
rs d2	S V [NegP	$[_{vP} t_v [_{PP} P no$]]]						*
* d3	SV [_{NegP} no	$\begin{bmatrix} vP \\ t_v \end{bmatrix} \begin{bmatrix} PP \\ P \end{bmatrix} P t$]]]	*!				*	
* d4	SV _{NegP} P no	$\int_{vP} t_v \int_{PP} t$	111		*!			*	

(303) Tableau 5: En, Fr, FS

Again, the transition from group 2 to group 3 can be accounted for by reranking a single constraint:



In English, the (b) and (d) competitions are actually not available because the main verb never leaves *v*P (with very few exceptions, see footnote 33). Because English has *do*-insertion, the

(a) and (b) competitions are identical and so are the (c) and (d) competition; they collapse into(a) and (c), respectively.

2.4.8.7 Constraint Reranking and Parametric Variation

The parametric variation in terms of constraint reranking is illustrated in the box diagram below, which makes it clear that this variation is rather minimal. The differences between the languages are accounted for by movement a single constraint (i.e. reranking) plus differences in crucial constraint rankings (adding or removing 'walls' in the diagram):



(305) Parametric variation

2.4.9 Summary and Conclusions

I have presented data that show an interesting variation in the licensing of sentential negation by NEG-shift across verbs and prepositions in English and the Scandinavian languages. English, Finland Swedish, and French are much more conservative than the other languages, which license NEG-shift to varying degrees. By treating the NEG-criterion as a violable constraint instead of an absolute principle in the analysis, the variation could be accounted for by minimal variation in the ranking of only six universal violable constraints.

If and only if NEGCRIT outranks STAY, the language has NEG-shift. The different preferences for pied piping, preposition stranding, or lexical substitution (neutralisation) can be derived from different rankings of P-LIC, *PERC, V-LIC, and ID. If *PERC outranks P-LIC, and if ID is ranked high, the language has stranding, whereas with P-LIC outranking *PERC, it has pied piping, as in group 1.a and 1.b, respectively. If both P-LIC and *PERC outrank ID, the result is neutralization, as in group 1.c. With V-LIC also outranking ID, the language has neutralization when either a verb or a preposition intervenes, as in group 2. Finally, with everything outranking NEGCRIT, the language has the negative object in situ, as in group 3.

2.4.10 Implications for Negative Subjects

Whether subjects move through spec-NegP or not depends on how the NEG-criterion is parameterized. A high ranking of NEGCRIT forces negative object to undergo NEG-shift. The question is whether negative subjects also move through spec-NegP on the way to spec-FinP. Spec-NegP must be filled either by movement or by merging something directly into it in order t check the EPP-feature on Neg^o.

(306) a. Da: <u>Ingen</u> har set filmen (ikke engang os) b. En: <u>No one</u> has seen the movie (not even us)

The question can be answered by considering the relative ranking of NEGCRIT and STAY established in section 2.4.8 above. In Danisg, as well as the other languages in group 1.a-c and 2 (see (305) above), the ranking is NEGCRIT » STAY. Movement of the subject through spec-NegP leaves a trace and satisfies NEGCRIT (by c-commanding and being co-indexed wit its trace) but violates STAY. This violation is licensed as the higher ranking NEGCRIT is satisfied: Filling spec-NegP is optimal:

(307)	Tableau	6: S	candina	vian
-------	---------	------	---------	------

			NEGCRIT	STAY
r 1	<u>Ingen</u> ₁ har [NegP t ₁	[_{vP} t ₁ set filmen]]		**
2	* <u>Ingen</u> 1 har [_{NegP}	$[_{\nu P} t_1 \text{ set filmen}]$	*!	*

Note that this movement is 'improper' because the A-chain headed by the subject *ingen* contains a trace in spec-NegP which is an \bar{A} -position. Normally, A-movement (movement for case) always precedes \bar{A} -movement such as *wh*-movement.

In English, and the other languages in group 3: French and Finland Swedish, it is more important to avoid movement than to satisfy the NEG-criterion and the ranking is the other way around. Therefore, skipping spec-NegP is optimal:

(308) Tableau 7: English

		STAY	NEGCRIT
1	* <u>No one</u> ₁ has [NegP t ₁ [$_{\nu P}$ t ₁ seen the movie]]	**!	
rs 2	<u>No one₁</u> has [$_{NegP}$ OP [$_{\nu P}$ t ₁ seen the movie]]	*	*

Whether or not the subject moves through spec-NegP has no empirical consequences as the subject cannot stay in spec-NegP. It is attracted to spec-FinP to check EPP and φ -features and to check nominative case. Also without empirical reflex is the choice between movement through and operator insertion into spec-NegP. In English, an operator is inserted when Neg^o is realized as the enclitic -n't; Danish does not have an enclitic version of Neg^o (cf. chapter 3, section 3.2) and hence, English allows empty operators in contexts where at least Danish does not. It is therefore unlikely that Danish has operator insertion instead subject movement through spec-NegP, whereas it is probably true for English.

2.5 Further Complications: Double Objects and Freezing Effects

I shall first give a brief outline of pronominal object shift and the target of and motivation for the movement. Next I shall discuss the so-called 'double object construction' and how constraints on Shape Conservation induces freezing effects when the indirect object is not a pronoun and therefore does not undergo object shift. Next I discuss neutralization of optionality of Icelandic full-DP object shift and freezing effects induced by the conflicting constraints on NEG-shift, object shift, and Shape Conservation.

2.5.1 Object Shift

The Scandinavian languages have Object Shift (OS) of weak (i.e. unstressed) pronominal objects (e.g. Vikner 1989: 146; 1994; 2001*a*), but only when the main verb has left *v*P (i.e. V2 or Icelandic V°-to-I°), cf. *Holmberg's Generalization* (Holmberg 1986, 1999). For example:

(309) Da: a. *Jeg
$$ved_v$$
 ikke $[v_P t_v det]$
b. Jeg $ved_v det_1$ ikke $[v_P t_v t_1]$
I know it not
"I don't know"

There are exceptions: Finland Swedish and Falster Danish (spoken in the areas around the islands Lolland and Falster) do not have OS of weak pronouns:

			"Yes,	you	see, I	don't	know	mysel	f."				(Berg	roth 1917: 172)
			Yes,	see	you,	Ι	know	it	not				SELF	
		b.	*Ja,	ser	du,	jag	vet_v	$\underline{\text{det}}_1$	inte	[vP]	t_v		selv]
(310)	FS:	a.	Ja,	ser	du,	jag	vet_v		inte	[vP]	t_v	det	selv]

Müller (2001) argues that the target of pronominal OS (and scrambling of pronouns) is a position in the domain of a functional head π° (π/pi for 'pronoun', presumably; this is the same as Johnson's 1991 µP though projected between TP and VP, Platzack's 1998: 137, µP projected between IP and Agr₀P, and Fischer et al.'s 2000: 125, FP, projected between CP and NegP). I take this π -projection to be located between FinP and NegP. According to Müller (2001), pronominal OS is motivated by *the Pronoun Criterion*:

(311) **The Pronoun Criterion (PRONCRIT)**

Weak pronouns must be in the [minimal] domain of π at S-Structure (Müller 2001: 289).

The tree structure in (313) below illustrates OS of an indirect object through spec- ν P (the escape hatch) targeting spec- π P (IO = Indirect Object, DO = Direct Object).

In Swedish and Norwegian, unlike the other Scandinavian languages, pronominal OS is optional:

(312) Sw: a. Jag
$$vet_v$$
 inte $[vP t_v det]$
b. Jag $vet_v det$ inte $[vP t_v t_1]$
I know it not

Icelandic is the only Scandinavian language that also has full-DP OS; apparently, direct scope mapping plays a higher role in Icelandic (see Vikner 2001*a*).

Note that the presence of a functional head, π° , with an available specifier is also necessary for OS under the constraint on multiple specifiers (177) (see also footnote 25, page 100).



(313) Pronominal OS:

Pronominal objects move to ensure convergence at the phonological interface; that is, pronominal OS is, presumably, motivated by prosodic constraints on syntax, say, the Pronoun Criterion.

In the next section I first discuss two different analyses of object shift in the 'double object construction' that observe the structure preserving constraint *Shape Conservation*: *Parallel Movement* and *VP Remnant Movement*. I then discuss how full-DP objects interfere with pronominal OS and induce neutralization of optionality of OS in Icelandic, Norwegian, and Swedish, before turning to the interaction between OS and NEG-shift which leads to freezing effects and neutralization depending on which objects is negative, pronominal, or a full-DP.

2.5.2 Double Objects

2.5.2.1 Parallel Movement vs. VP Movement

In the so-called 'double object construction', OS has to preserve the base-generated or initial word order of the two objects (Scandinavian and English: IO-DO, German: DO-IO). Müller (2001) proposes that this is due to *the Parallel Movement Constraint*:

(314) Parallel Movement Constraint (PARMOVE)

If α c-commands β at level L_n , then α c-commands β at level L_{n+1} (where α , β are arguments). (Müller 2001: 279, (1))

I take this to be an instance of a more general constraint, *Shape Conservation*, itself another instance of *Unambiguous Encoding* (see section 2.4.2):

(315) Shape Conservation (SC)

Feature checking in the domain of a head Y must not change the linear order of lexical items established in vP within YP. (Müller 2000: 6, (17))

As the following Danish examples (representative for Icelandic and Faroese as well) show, PARMOVE must be obeyed:

(316) Da: a. Jeg lånte_v ikke [$_{vP}$ t_v Marie bogen] ikke [$_{vP}$ t_v hende b. *Jeg lånte_v bogen] c. Jeg lånte_v <u>hende₁</u> ikke [$_{vP}$ t_v t₁ bogen] d. Jeg lånte_v <u>hende</u>₁ <u>den</u>₂ ikke [$_{vP}$ t_v t₁] t_2 Т lent her it not (Mary) (the.book) "I didn't lend Mary/her the book/it."

As (317)a shows, the Pronoun Criterion may also be violated in order to satisfy PARMOVE:

(317) Da: a. Jeg låntev ikke [vp tv Marie den]
b. *Jeg låntev den2 ikke [vp tv Marie t2]
I lent it not Mary
"I didn't lend it to Mary."

When both objects are pronominal, they must both undergo OS in Danish, Faroese and Icelandic:

(318) Da: a. *Jeg gav ikke hende den den ikke hende b. *Jeg gav с. hende ikke *Jeg gav den d. Jeg gav hende den ikke Ι gave her it not

Under the Parallel Movement analysis, the direct object DO moves to spec- π P and the indirect object IO adjoins to π P and the base-generated word order is preserved. Assuming phases, movement is through the edge of *v*P. Note that at the *v*P phase level, PARMOVE is violated: IO, being closest to v° , is attracted first to spec-*v*P, and then DO is attracted to the outermost spec-*v*P:

(319) Parallel Movement:



Note that any successive-cyclic derivational analysis of OS also violates *the Minimal Link Condition* (MLC, Shortest Move/Closest Attract/Relativized Minimality) under the *VP-internal Subject Hypothesis*. The parallel movement analysis just induces a second violation as the two objects have crossing paths. Moving the subject to spec-TP violates the MLC. Chomsky (2001) argues that a shifted object in spec-*v*P is 'inactive' because it has already been assigned case; further movement is driven by phonology. However, that does not account for MLC violations in topicalization of objects, *wh*-movement, NEG-shift, etc. It appears that a violation of MLC is unavoidable as all movement is done in narrow syntax.

The Parallel Movement analysis captures the data nicely. However, as XP movement is triggered by EPP-features there can be no movement to an adjoined position, and hence, πP must have two specifiers, one for each object. As argued in section 2.3.9, multiple specifiers are otherwise only needed (and thus only licensed) at phase edges. Assuming this restriction to hold, an alternative analysis must be adopted. I shall still assume the driving feature to be located on π° (the Pronoun Criterion) and hence the target of OS to be spec- πP , and that such movement is subject to a constraint on Shape Conservation (SC).

The obligatory word order preservation in double object shift is also discussed by Vikner (1989), who suggests that what is moved is the entire lower VP-shell, i.e. [$_{VP}$ IO t $_{\nu}$ DO], which he labels δP (Vikner 1989: 148; see also Larson 1988). (Vikner 1989 and 1994 assumes OS to be adjunction to VP.) Under the present analysis it would look as follows:



(320) VP Remnant Movement:

The VP remnant movement analysis 'only' requires feature percolation from D^o in order to allow VP to check a nominal feature (a process needed for other movement as well, cf. e.g. section 2.4.8.1) in exchange for avoiding the additional multiple specifiers (apart from at strong phase edges).

VP-movement to spec- π P is only possible when Shape Conservation (SC, see (315) above) is respected, i.e. the movement is 'parallel', AND both objects are weak pronouns. Otherwise, for example a negative object would have to involve lowering / rightward movement from spec- π P to spec-NegP (the same problem arises when one of the pronominal objects are stressed / focalized and remain in situ): the [Neg] feature can not percolate to VP and therefore NEG-shift of VP can not apply prior to OS.

Assuming that OS to πP is motivated by prosodic considerations (rather than being an operation on objects per se) accounts for the fact that it also applies to adverbial adjuncts as well, such as *her* 'here' and *der* 'there', as noted by Haider et al. (1995: 20) (see also Josefsson 2003: 203).

(0=1)	24.	b.	*Peter	sov	<u></u> 1	alligevel	ikke	der			
			Peter	slept		after-all	not	there			
			"Peter	didn't s	leep t	here after all	"		(Haider et al.	1995: 2	0, (45))

"*Der* is presumably not a DP and does not receive case at all" (Haider et al. 1995:21). Still, movement is dependent on EPP-features and unvalued/uninterpretable features on probes, say [*u*Pron] (presumably uninterpretable even when valuated and must therefore be deleted from both probe and goal). *Der* could be analyzed as the complement of a phonologically empty preposition or determiner, i.e. [_{DP} D^o [_{AdvP} *der*]], which is pied-piped in OS, compare:

(322) Da: a. Peter sover ofte [i sengen <u>her/der]</u>
c. Peter sover <u>der/her_1</u> ofte
Peter sleeps there/here often in bed.the there/here

When there is both a pronominal object and a pronominal adverbial in the clause, only the object can undergo OS:

(323)	Da:	a.	Peter	mødte			ikke	pigen	i	haven
		b.	Peter	mødte	\underline{hende}_1		ikke	t ₁	i	haven
		с.	*Peter	mødte			ikke	hende	der	
		d.	*Peter	mødte	\underline{hende}_1		ikke	t_1	der	
		e.	*Peter	mødte		\underline{der}_1	ikke	pigen	t_1	
		f.	*Peter	mødte	\underline{hende}_1	\underline{der}_2	ikke	t_1	t_2	
			Peter	met	her	there	not	(girl.the)	(in	garden.the)

The ungrammaticality of (323)c-e is due to the (violations of the Pronoun Criterion due to) the unchecked EPP-feature on π° which is inserted to ensure convergence at the phonological (prosodic) component. The ungrammaticality of (323)f could be is accounted for by assuming *der* to be right-adjoined to *v*P. EPP on π° can be checked by pronouns or by VP (with double objects). Pied-piping *der* would involve *v*P movement which is not licensed³⁷, so the two pronominals can not move together; they can not both move to π P independently either, as there is only one specifier position available as a target.

So far, in Danish, Faroese, and Icelandic, pronominal object must undergo OS, either alone, as in (313), (in mono-transitive sentences or, in Danish and Faroese, when IO is pronominal and IO is a DP), or together as VP in case of double pronominal objects, as in (320). In Finland Swedish and Falster Danish OS is blocked. In Norwegian and Swedish, OS is optional: either a single object moves or it remains in situ, or in case of double objects, IO may optionally move to spec- π P while DO remains in situ or they may either stay or move together. In all cases, movement is shape conserving: it maintains or re-establishes the base order of the two objects.

(324)Sw: a. Jag gav inte henne den b. *Jag gav den inte henne с. Jag gav henne inte den d. Jag gav henne den inte Ι gave her it not

Certain variants (at least) of Norwegian (No⁺) and Swedish (Sw⁺) allow non-base-orders of the two objects.³⁸ OS is 'symmetric' as both IO-DO and DO-IO order are allowed. In No⁺, this reverse order is only allow when both objects have undergone OS:

 $^{^{37}}$ Whether that is also the case or not in the 'symmetric' OS languages No^{+} and Sw^{+} is an open empirical question.

³⁸ Josefsson (2003: 204-206) argues that the DO-IO word order is a myth; OS of DO can not cross IO in Swedish. See also footnote 39.

(325) No⁺: a. Eg ga ikkje ho den Eg ga ikkje <u>den</u> b. ho <u>ho</u> <u>den</u> ikkje с. Eg ga d. *Eg ga ikkje den ho *Eg ga ikkje ho e. den f. Eg ga den ho ikkje (Peter Svenonius, p.c.) I gave it her not

In Sw^+ , on the other hand, any combination of optional OS and the base or reverse order is permitted – surprisingly including *v*P-internally:

I propose that in these '+' variants of Norwegian and Swedish, when the reverse order is observed vP has undergone OS. The direct object DO moves to spec-vP while IO remains in situ (step 1 in (327) below). Assume that the [Pron] feature on IO (in spec-VP) percolates all the way to vP, it will be the closest matching goal for the probing [uPron] feature on π° . In this way, the whole vP (remnant) is pied-piped under OS. In Sw⁺, subsequent movement to spec- π P (step 2) is optional; in No⁺, it's obligatory:



Note that the derived DO-IO order is the one that has to be maintained in order to satisfy Shape Conservation (SC) according to the definition in (315) above.

This optional reversed order is not licensed in the other Scandinavian languages, neither step 1 nor step 2. The crucial difference could then be taken to be that in Danish, Faroese, Icelandic, and Swedish, a [Pron] feature can percolate only as high as VP, while in Norwegian⁺ and Swedish⁺, it can percolate all the way to vP.

This is very similar to the solution proposed by Anagnostopoulou (2003: 157, (236))³⁹ who suggests that languages like No⁺ and Sw⁺ license an intermediate short VP-internal OS that reverses the order of the two objects. The next step would then correspond to the parallel movement solution outlined above.

In Icelandic, which has optional OS of full-DPs, OS must respect the underlying IO-DO word order:

³⁹ Anagnostopoulou (2003: 123-127) relates the possibility of symmetric OS to the Norwegian and Swedish symmetric passive. That is, both DO and IO can raise to subject under passivization which is not possible in Danish and Icelandic:

⁽i) Jon_1 ble gitt t_1 en bok

⁽ii) En bok₂ ble gitt Jon t_2

A book was given John

However, it does not hold for Faroese which has symmetric passive (cf. Thráinsson et al. 2004: 231) but not symmetric OS.

(328)	Ic:	a.	Ég	gaf			ekki	manninum	<u>gjöfina</u>
		b.	Ég	gaf	$\underline{manninum}_1$		ekki	t_1	<u>gjöfina</u>
		с.	*Ég	gaf		gjöfina ₁	ekki	manninum	t_1
		d.	Ég	gaf	$\underline{manninum}_1$	gjöfina ₂	ekki	t_1	t_2
		e.	*Ég	gaf	gjöfina ₂	$\underline{manninum}_1$	ekki	t_1	t_2
			I	gave	present.the.ACC	<i>man.the.</i> DAT	not		
			"I d	didn't	give the man the pres	sent."			

2.5.2.2 DP and Pronominal Objects

When IO is a full DP and DO a pronoun in Icelandic, both objects must shift, regardless of scope. Thus, optionality of full-DP OS is neutralized:

(329)	Ic:	a.	?Ég	gaf			ekki	manninum	það
		b.	*Ég	gaf		það ₂	ekki	manninum	t_2
		с.	*Ég	gaf	$\underline{manninum}_1$		ekki	t_1	það
		d.	Ég	gaf	$\underline{\texttt{manninum}}_1$	það ₂	ekki	t_1	t_2
			Ι	gave	<i>man.the.</i> DAT	it.ACC	not		
			"I c	didn't	give it to the ma	nn''			

In the other Scandinavian languages, which do not normally have full-DP OS, both objects remain inside vP. However, it is interesting to note that full-DP OS which reestablishes the base order, (330)d, is better than the version where pronominal OS applies across the DP IO, (330)b, and the version where only the DP IO shifts. In short, leaving both objects in situ is fully grammatical (unmarked), while repair-driven full-DP OS is highly marked, if not ungrammatical, but less so than other versions. This is the mirror image of Icelandic, where the in situ version is marked, while double OS is unmarked (obligatory).

(330)Sw: a. Jag visade inte Elsa den (förrän langt senare) *Jag visade b. den inte Elsa (förrän langt senare) *Jag visade <u>Elsa</u> с. inte den (förrän langt senare) d. ??Jag visade Elsa den inte (förrän langt senare) showed Elsa it Т not (until much later) "I didn't show it to Elsa until much later."

(Anagnostopoulou 2003: 128 (189);

the '??' judgement is due to Maia Andreasson, p.c.)

(331) No: a. Jeg ga ikke Peter dem (før dagen efter) b. *Jeg ga ikke Peter (før dagen dem efter) *Jeg ga с. Peter ikke dem (før dagen efter) d. ??Jeg ga Peter dem (før dagen efter) ikke gave Peter them not (until day.the after) Τ "I didn't give them to Peter until much later."

(Marit Julien, p.c.)

When the IO is a pronoun and DO is a full DP, the pronouns are free to, and therefore must, undergo OS. The direct object DP can either stay in situ or shift according to scope:

(332) Ic: a. *Ég gaf ekki honum gjöfina b. Éq qaf honum₁ ekki tı gjöfina с. Ég gaf honum₁ gjöfina₂ ekki tı t_2 d. *Éq qaf gjöfina₂ ekki honum t₂ I gave him present.the not "I didn't give him the present."

2.5.3 NEG-shift and Double Objects

2.5.3.1 NEG-shift and Pronominal Objects

Consider first NEG-shift of DO together with OS of a pronominal IO. In Danish, Faroese, Icelandic, Norwegian, and Swedish, the pattern is the same. In clauses with the main verb in V2, both OS and NEG-shift applies:

(333) Da:
 a. *Jeg lånte faktisk <u>hende(IO)</u> ingen bøger(DO)⁴⁰
 b. *Jeg lånte faktisk <u>ingen bøger(DO)</u>
 c. Jeg lånte <u>hende(IO)</u> faktisk <u>ingen bøger(DO)</u>
 I lent her actually no books
 "I actually didn't lend her any books."

In clauses with auxiliary verbs, only NEG-shift is possible and indeed obligatory, even though it reverses the order of the two objects; that is, SC (315) is not respected:

⁴⁰ This is grammatical (at least in Danish and Icelandic) if the pronoun *hende* is stressed, which is also to be expected as stressed pronouns remain in VP in Danish.

```
(334) Da:
a. *Jeg har lånt hende(IO) ingen bøger(DO)
b. Jeg har ingen bøger(DO) lånt hende(IO)
c. *Jeg har hende(IO) ingen bøger(DO) lånt
I have her no books lent
"I actually haven't lent her any books."
```

Note that in Swedish and Norwegian, optionality of OS is neutralized: IO must shift and reestablish the base order of the objects.

(335) Sw: a. *Jag lånte ingen bøger(DO) henne(IO)
b. Jag lånte henne(IO) ingen bøger(DO)
I lent her no books

Consider next NEG-shift of the IO together with OS of a pronominal DO. In Danish, Faroese, Icelandic, Norwegian, and Swedish, OS is blocked because it results in non-parallel movement:⁴¹

(336) Da: a. Jeg lånte faktisk <u>ingen(IO)</u> den(DO)
b. *Jeg lånte <u>den(DO)</u> faktisk <u>ingen(IO)</u>
I lent it actually no-one
"I actually lent it to no one."

For Swedish and Norwegian, this is the mirror image of the neutralization effect observed in (335): OS is neither optional nor obligatory; it's ungrammatical. In other words, NEG-shift induces a freezing effect: DO is frozen in place.

In sentences with compound tense, the main verb in v° blocks OS. NEG-shift does not violate Shape Conservation, cf. (337)b:⁴²

(337)	Da:	a.	*Jeg	har		faktisk		lånt	ingen(IO)	den (DO)
		b.	Jeg	har		faktisk	ingen(IO)	lånt		den (DO)
		с.	*Jeg	har	den (DO)	faktisk	ingen(IO)	lånt		
			I	have	it	actually	no.one	lent		

⁴¹ According to Hrafnbjargarson (p.c.), (336)b is also grammatical in Icelandic if the indirect object is focus / new information.

⁴² According to Falk (1990), Holmberg (1991), Holmberg and Platzack (1995), Collins & Thráinsson (1996), Anagnostopoulou (2003), Icelandic class 1 ditransitive verbs such as *gefa* have a double base: The objects can be generated with either IO-DO or DO-IO order (see also Hrafnbjargarson 2005: 53). Both (336)b and (337)a would be grammatical with *gefa* 'give' instead of *lána* 'lend'.

In Finland Swedish neither NEG-shift nor OS apply, and hence there are no further complications associated with double objects: both remain in situ. Falster Danish does not have OS, but it's an empirical question whether it has NEG-shift or not, and if so, what happens in double object constructions.

2.5.3.2 NEG-shift and DP Objects

Recall that OS of full DPs is not licensed in the Mainland Scandinavian languages and Faroese:

The pattern is the same for Icelandic, which do allow full-DP OS. When IO is a NegQP it obligatorily undergoes NEG-shift and OS of DO is blocked as it would violate SC: the word order would be reversed.

When DO is a NegQP and IO a full DP, Icelandic has both full-DP OS and NEG-shift. However, the optionality of OS of full DPs is neutralized by a NEG-shifted direct object. Both NEG-shift and OS are obligatory in this context as it re-establishes the original IO-DO order:

In Danish, Norwegian (Marit Julien, p.c.) and Swedish (Elisabet Engdahl, p.c.), the repairdriven OS, as in (339)b, is not licensed, cf. (340)b; in the only grammatical version, both objects follow the sentence-medial adverbial particle *jo* which shows that neither OS nor NEG-shift has applied:

"I didn't give the child anything, you know."

This is another example of neutralization. The IO-DO word order must be maintained; OS cannot apply to full DPs and therefore the NegQP DO is spelled out in situ and NEG-shift is forced to apply covertly.

(341) Ic : a. Ég gaf <u>manninum(IO)</u> víst <u>enga gjöf(DO)</u>
b. Ég gaf víst <u>manninum(IO)</u> <u>enga gjöf(DO)</u>
I gave PRT man.the.DAT no present.ACC
"But I did give the man the present."

In (341)a IO has undergone OS as it precedes the medial adverbial; DO has undergone stringvacuous NEG-shift. In (341)b, on the other hand, none of the operations has applied. As Icelandic full-DP OS is scope-driven, the OS is optional. Leaving IO in situ, however, induces a freezing effect on NEG-shift of DO (the latter, a DP IO in situ blocking NEG-shift, is the same in the other Scandinavian languages):

(342)	a. [_{CP} Subj Verb [$_{\pi P}$ IO Adv [_{NegP} DO]]] +OS, +NEG-shift	= (341)a
	b. [_{CP} Subj Verb Adv [_{NegP} [_{vP} IO DO]]] -OS, -NEG-shift	=(341)b

2.5.4 Summary

The following table is a summary of the movement patterns in double object constructions (I leave out Falster Danish because of lack of empirical data).

IO-DO	Ic	Da, Fa	No, Sw	No^+, Sw^+	FS
a. Pron-Pron	++	++	%%	§ §	
b. Pron-NegQP	++	++	++	++	
c. NegQP-Pron	+ -	+ -	+ -	+ -	
d. Pron-DP	+ %	+ -	% -	% -	
e. DP-Pron	% -				
f. DP-DP	%%				
g. DP-NegQP	% %				
h. NegQP-DP	+ -	+ -	+ -	+ -	

(343) Summary of OS and NEG-shift:

Object: Pron = pronoun, NegQP = negative quantifier phrase, DP = full DP**Movement**: + = obligatory, - = blocked, % = optional, § = optional and 'non-parallel' For example, in Icelandic, if IO-DO = Pron-DP then IO must undergo obligatory OS (+) while for DO it is optional (%). (The choice is rather between OS of a DP or a VP.) In all the languages, when IO-DO = NegQP-DP, NEG-shift obligatorily applies to IO (+), while OS of DO is blocked (-) as it would result in a reversal of the base-order of the objects.

It is interesting to note that obligatory NEG-shift induces a **freezing effect** on OS in all the languages, resulting in **neutralization** of optionality in Icelandic, Norwegian, and Swedish, cf. (343)c and h.

When IO=NegQP and DO=Pron, and the main verb in V2 position, it results in neutralization of OS optionality in Swedish and Norwegian, even in the 'reversible' variants Sw^+ and No⁺: OS is **blocked** in all Scandinavian languages and Shape Conservation (SC) is respected. When the main remains in v° (see (337) above), OS is blocked while NEG-shift is obligatory.

When IO=Pron and DO=NegQP (cf. (343)b), it also leads to neutralization of OS optionality in Swedish and Norwegian: OS is **obligatory** in all Scandinavian languages and SC is respected. With the main verb in v° (see (334) above), OS is **blocked** while NEG-shift applies and violates SC.

As Icelandic is the only language that has full-DP OS, it is the only language affected when IO=NegQP and DO=DP (cf. (343)h). NEG-shift applies obligatorily to IO; to maintain Shape Conservation optionality of full-DP OS is neutralized: OS is **blocked**. On the other hand, when IO=DP and DO=NegQP (cf. (343)g) the full-DP IO in spec-VP induces a **freezing effect** on overt NEG-shift as it would result in the reverse word order and violate of SC. This applies to all the languages. However, in Icelandic, IO may also optionally undergo OS clearing the way for NEG-shift.

The observed conflicts and their effects strongly suggest an Optimality-Theoretic analysis with violable conflicting constraints. An outline of such an analysis would begin with three information structure constraints: *Shape Conservation* SC, the *NEG-criterion* NEGCRIT, and the c-command requirement on objects V-LIC (a subcomponent of the more general SC), and one prosodic constraint, namely, the Pronoun Criterion PRONCRIT.

Leaving much detail aside (neutralizations in Scan2, OS of full DPs in Icelandic, nonapplicability of pronominal OS in Finland Swedish⁴³), NEG-shift applies across the verb, and hence the NEG-criterion is more important than the c-command requirement: NEGCRIT » V-LIC (cf. section 2.4.8.7). Furthermore, OS only applies when the verb does not intervene,

⁴³ The lack of OS in Finland Swedish and Falster Danish is accounted for by ranking PRONCRIT below STAY; for an analysis of OS of full DPs, see Vikner (2001*a*).

which shows that the c-command requirement is more important than the Pronoun Criterion, hence: V-LIC » PRONCRIT. As a full-DP IO in spec-VP blocks NEG-shift, considerations of Shape Conservation overrides the NEG-criterion, which means than SC and NEGCRIT are ranked as follows: SC » NEGCRIT.

The three sub-hierarchies together result in the constraint hierarchy in (344) below which is shared by all the languages:

(344) SC » NEGCRIT » V-LIC » PRON

This constraint hierarchy accounts for the cases where one object is a pronoun and the other a NegQP. In the competition in (345) the optimal candidate 3 has both OS and NEG-shift. Candidate 1 satisfies SC but fatally violates the NEG-criterion; candidate 2 fatally violates SC which bans the DO-IO order (unless established inside vP which is possible with double pronominal objects).

(345) Tableau 8

	Input: IO Main ver	Pron DO _{NegQ} b in C ^o	Р	SC	Neg Crit	V-LIC	Pron Crit		
* 1	Verb	NegP	[_{vP} IO	DO]]		*!		*
* 2	Verb	[NegP DO	[vP IO]]	*!			*
B 3	Verb IO	[NegP DO	vP]]				

In (346), the optimal candidate, the winner of the competition, is candidate 2 where NEG-shift applies and OS is blocked which violates PRONCRIT. Candidate 1 maintains base-order of the objects and fatally violates NEGCRIT; candidate 3 has both NEG-shift (satisfying NEGCRIT) and OS (satisfying PRONCRIT), which fatally violates SC: moving the pronominal DO across IO in spec-NegP reverses the order of the objects.

(346)	Tableau	9
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	Input: IO _N	NegQP DOPro	n	SC	NEG	V-LIC	Pron		
	Main verb	o in C°			Crit		Crit		
* 1	Verb	[NegP	[_{vP} IO	DO]]		*!		*
₽ \$* 2	Verb	[NegP IO	vP	DO]]				*
* 3	Verb DO	[NegP IO	[vP]]	*!			

Problems arise, however, when the main verb stays in v° (as in embedded clauses or when a finite auxiliary satisfies the V2 requirement). In the competition in (347), IO=Pron, DO=NegQP (see example (334)b), the wrong candidate wins. Candidate 2 is the

ungrammatical version but it fatally violates SC which is not violated by its competitors (the sour face \otimes indicates that it should have been the winner). The winner is the ungrammatical candidate 3 with both NEG-shift and OS across the verb.

	Input: IO _{Pron} D Main verb in v	O _{NegQP}	SC	Neg Crit	V-LIC	Pron Crit	
* 1	NegP	[vP Verb IO	DO]]		*!		*
⊗2	[_{NegP} DO	[_{vP} Verb IO]]	*!		*	*
rs * 3	IO [NegP DO	[_{vP} Verb]]			**	

(347) Tableau 10

On the other hand, when IO=NegQP and DO=Pron there is no problem. Candidate 2 with NEG-shift and blocked OS is optimal:

(348) Tableau 11

	Input: IO _{NegQP} Main verb in v	DO _{Pron}	SC	Neg Crit	V-LIC	Pron Crit		
* 1	NegP	[vP Verb IO	DO]]		*!		*
₽ \$* 2	[_{NegP} IO	[vP Verb	DO]]			*	*
* 3	DO [NegP IO	$[_{\nu P} Verb$]]	*!		**	

What remains, then, is a way to account for NEG-shift violating SC as in (334)b and (347), candidate 2, a problem for future research.

3 The Negative Adverbial Operator

3.1 Road Map: The Negative Operator and the Clausal Spine



(349) Position of NegAdvP:

3.2 X^o or XP status: NEG-topicalization

3.2.1 Introduction

Negation can be either X^o or XP. In English, Icelandic, Norwegian, and Swedish, there are clearly two versions of the negative operator, namely, an XP and a clitic X^o, whereas Danish and Faroese only have one which I shall argue is an XP. The languages differ in whether they allow the operator to be topicalized, which could be taken as an indicator of categorial status. However, I shall argue that English *not* and Danish *ikke* are phrases even though they can not be topics.

I present an analysis of the cross-linguistic (synchronic and diachronic) variation using three optimality theory constraints on information structure: LEXTOP, a semantic weight principle, and TOPCRIT, requiring the topic to be in spec-CP, i.e. old information first, and OPSC which states that syntactic operators must be in scope positions.

3.2.2 The paradox

In Danish and English, the negative operator *ikke/not* cannot be topicalized, whereas most other adverbials (but not all, cf. section 3.2.4 below) can.

(350) a. Da: *<u>Ikke</u> har jeg læst den dumme bog.
b. En: *<u>Not</u> have I read that stupid book.
(351) a. Da: Aldrig har jeg læst noget så dumt.

b. En: Never have I

(In English, topicalization of negative constituents, or monotone decreasing / downward entailing elements, but not positive constituents, triggers verb movement to C°, a phenomenon known as Negative Inversion (NI); I disregard that here as it is not crucial to the argumentation.)

read anything so stupid.

As the target of topicalization is spec-CP, elements that can be topicalized must be XPs. Therefore, the fact that *ikke* and *not* can not be topicalized could be taken to show that they are X^os.

Analyzing negation as Neg^o would hold for English and Danish alone but not for the very closely related Faroese, Icelandic, Norwegian, and Swedish, where the topicalizable

negation markers must be XPs (the same goes for Finland Swedish, cf. Bergroth 1917: 168, §251):^{44,45}

(352) Fa: <u>Ikki</u> ljóðar tað væl. Not sounds that well (Lockwood 2002: 155)

(353) Ic: <u>Ekki</u> leika stelpurnar sér að dúkkum. Not play girls.the SELF.DAT with dolls.DAT

(Svavarsdóttir & Jónsdóttir 1988: 89)

(354) No: <u>Ikkje</u> var det sett opp noko varsel om denne faren. Not were it put up any warning about this danger.the (AV/Loka/01)

(355) Sw: <u>Inte</u> tänker han sälja bilen i vår. Not thinks he sell car.the in spring

(Holmes & Hinchliffe 2003: 470)

Alternatively, the Swedish –*nte* could be analyzed as the result of phonological cliticization of adjacent elements (e.g. *har inte* 'has not' \rightarrow *hante*, see example (359)b) rather than being a syntactic clitic. In Swedish main clauses, both the finite verb and the non-clitic sentential negation (as well as the topic) may precede the subject, e.g. *idag kommer (inte) Peter (inte)* 'Peter isn't coming today' (Holmes & Hinchliffe 2003: 477). In embedded clauses, negation may precede the subject, e.g. *att (inte) Johan (inte) gillar prinsesstårta* 'that Johan does not like princess cake' (Sells 2000: 2). In chapter 0, section 2.3.11, this is taken to suggest that the subject in Swedish, as well as Norwegian, may occupy a position lower than spec-NegP, namely, spec-TP. It is therefore possible that the *-nte* version of *inte* may be the result of phonological cliticization. However, I disregard this possibility here.

At least in Norwegian (cf. Faarlund et al. 1997: 814) and Swedish (Platzack, p.c.), fronting of negation is usually accompanied with focal stress, which seems to imply focalization rather than topicalization. Assuming the Split-CP Hypothesis (Rizzi 1997), the former would be movement to FocusP, the latter movement to TopicP. However, focalization

⁴⁴ NEG-topicalization may depend on a certain context and intonation to be felicitous; the important fact is, however, that it is possible in some languages and not in others, regardless of context.

⁴⁵ The Norwegian example is from the Nynorsk corpus at the *Tekstlaboratoriet* at the University of Oslo, <u>http://www.hf.uio.no/tekstlab/</u>. The webpage gives no more specific data on the origins or dates of the text other than *lokalaviser*, 'local newspapers'.

in the Scandinavian languages as well as in English normally requires only emphatic stress, not movement, while topicalization is always movement. Thus, Danish *ikke* and English *not* can be focalized (phonological process) but not topicalized (syntactic process) while the other languages in question have no such restriction. Furthermore, the focal stress is often on a constituent other than the fronted negation, e.g. Sw: *Inte vet JAG* 'I don't know (but someone else might)'. In Icelandic, there has to be focal stress on one of the constituents following the topicalized negation, e.g. ég 'I' in (353). Moreover, in Finland Swedish there is no contrastive or focal stress involved (cf. Bergroth 1917: 168), neither on negation nor on a following constituent, and it is clearly not focalization of negation. It must be topicalization.

In English as well as in Icelandic, Norwegian, and Swedish, it is clear that there are two versions of the negation marker, namely, English *not/-n't*, Icelandic *ekki* [ɛhcɪ]/-*ekki* [IcI], Norwegian *ikke/-kke*, and Swedish *inte/-nte*.⁴⁶

(356) En: a. Has John <u>not</u> read the book? b. Has-<u>n't</u> John read the book?
(357) Ic: a. Hefur Jón <u>ekki</u> lesið bókina? b. Hefur-<u>ekki</u> Jón lesið bókina?
(358) No: a. Har Johan <u>ikkje</u> lest boka? b. Ha-<u>kkje</u> Johan lest boka?
(359) Sw: a. Har Johan <u>inte</u> läst boken? b. Ha-nte Johan läst boken?

The two versions of the negation marker occupy different structural positions. The full version is an XP in spec-NegP, whereas the clitic version, which moves with the verb to C^o, is base-generated (or licensed) in Neg^o (as indeed argued for English by Roberts 1993: 279). This is also the case with French *pas* and *ne*-, respectively (the latter is disappearing in modern colloquial French (Nølke 1997: 230, Pedersen et al. 1996: 428-429).⁴⁷

⁴⁶ In Icelandic, if the subject is a pronoun, negation has to follow the enclitic subject:

⁽i) Ic: *Hefur-<u>ekki</u> hann lesið bókina? Has-not he read book.the

⁽ii) Ic: Hefur-ann-<u>ekki</u> lesið bókina? Has-he-not read book.the

⁴⁷ Note also that -n't and *not* may have different scope properties (cf. Cormack & Smith 2002). This is captured by the present analysis as the clitic version moves with the verb to a higher position while *not* remains low in spec-NegP.



Unlike French which has Negative Concord (i.e. multiple negations do not cancel each other out: *Je n'ais rien donné à personne*, Lit. I not-have nothing given to no-one, 'I didn't give anything to anyone')⁴⁸, only one of the two positions may be filled at one time: filling more than one, will be double negation which gives a positive interpretation (*I didn't not steal your wallet* = *I stole your wallet*). Like Icelandic, French has 'V°-to-I°' movement – the finite verb always moves to Fin° above Neg°. The proclitic *ne* always precedes the finite verb (*ne* is prefixed to the verb regardless of orthography) while *pas* 'not' follows it. The verb moves through Neg° picking up *ne*- on the way to Fin°. As *pas* remains in spec-NegP, the order of the two negative elements is reversed:



For example :

⁴⁸ Unlike the other negative elements in French, *pas* 'not' does not enter into negative concord (Nølke 1997: 232); when present with other negative elements it gives rise to double negation:

⁽i) Fr: J'ais pas rien donné à personne

I-have not nothing given to no-one "I didn't nothing to anyone."

(362) Fr: Pierre <u>n'a</u> pas voulu de cadeaux.
 Pierre NEG-has not wanted of presents
 "Pierre didn't want any presents." (Rowlett 1998:84, (63a))

In the case of *ikke* and *not*, however, cliticization is not possible; they do not move with the verb to C^o. This suggests that they are XPs, not X^os:

(363) Da: a. Har Johan <u>ikke</u> læst bogen?
b. *Har-<u>ikke</u> Johan læst bogen?
(364) En: a. Has John <u>not</u> read the book?
b. *Has-not John read the book?

Danish *ikke* appears to have the same categorical status as English *not*, which must be an XP as opposed to *-n't*. The set of elements that can be topicalized is parallel in Danish and English: all negative adverbials except *not*.

(365) Da: a. <u>Under ingen omstændigheder</u> vil jeg læse det sludder.
b. <u>Aldrig</u> vil jeg læse det sludder.
c. *<u>Ikke</u> vil jeg læse det sludder.
(366) En: a. <u>Under no circumstances</u> will I read that nonsense.
b. <u>Never</u> will I read that nonsense.
c. *<u>Not</u> will I read that nonsense.

Actually, there is another exception, namely, næppe/hardly:

(367) a. Da: *<u>Næppe</u> vil jeg læse det sludder.
 b. En: *<u>Hardly</u> will I read that nonsense.

Both are fine with a temporal reading such as:

(368) a. Da: <u>Næppe</u> var jeg ankommet før jeg måtte rejse igen.
 b. En: <u>Hardly</u> had I arrived before I had to leave again.

In short, the paradox, then, is that *ikke* and *not* appear to be both Spec-NegP and Neg^o or neither:



A number of linguists have argued that English *not* is the head of NegP because is requires *do*-support, supposedly because *not* blocks verb movement (e.g. Grimshaw 1995: 18, Poole 2002: 272, Radford 1997: 231-232; but see Pollock 1989: 421-422 who argues that *not* may be in spec-NegP). However, I shall present evidence in favour of analyzing both English *not* and Danish *ikke* as XPs rather than X°s, thus ruling out (369)b and d, and that the lack of topicalizability is due to their semantic 'lightness'.

3.2.3 Islands

3.2.3.1 Inner Islands

Sentential negation may trigger an island effect, a so-called *inner island*. *Wh*-extraction across NegP is not possible in (370)a, while the positive version in (370)b does not block extraction. The fact that negation may block \bar{A} -movement suggests that spec-NegP is filled.

(370)Da: a. *Det er frygteligt hvor klog1 du ikke er t1 is terrible It how clever you not are b. Det er frygteligt hvor dum₁ du er t_1 is terrible Ιt how stupid you are (Vikner 2001b: 203 (81a), (82a))

The same can be observed in English. However, the fact that the enclitic -n't has the same blocking effect shows that it does not matter whether negation is realized as an X^o or as an XP (as argued by Vikner 2001*b*: 203):

In other words, negative islands do not give any conclusive evidence in favour of either the X^o or the XP analysis. More importantly, it does not give conclusive evidence against analyzing the negative markers as XPs.

It seems reasonable to analyse Danish *ikke* and English *not* as overt operators in spec-NegP rather than as the head of NegP, though there is no direct empirical evidence to support it. Hence, the structures in (369)b and d above are out and (369)a and c, repeated here as (372), are preferable:



3.2.3.2 Stylistic Fronting

Stylistic Fronting (SF) is "a leftwards movement of e.g. an adverb, or a participle, or a verb particle, etc. into a position that precedes the finite verb" (Hrafnbjargarson 2004: 181) licensed by a subject gap, the lack of an overt subject. The elements that can undergo SF can be ordered in an accessibility hierarchy (Hrafnbjargarson 2004, Maling 1990), based on locality:

(373) Accessibility hierarchy for stylistic fronting:

$$\begin{cases} negation \ ekki, \\ sentential \ adverbials \end{cases} > \begin{cases} past participle \\ verbal \ particles \end{cases} > predicative \ adjective \\ (Hrafnbjargarson 2004: 186, (15)) \end{cases}$$

According to Hrafnbjargarson (2004: 190), SF is motivated by a [F(ocus)] feature which must be checked and deleted on Foc^o, the head of FocusP projected between CP and FinP (his TopicP and IP), either by adjunction to Foc^o or by XP movement to spec-FocusP. Once [Focus] is checked, further movement to FocusP is superfluous and by economy not licensed which accounts for the fact that only one element, X^o or XP, can undergo SF.

Icelandic negation *ekki* 'not' blocks SF of any other (lower positioned) element, head or XP, and therefore SF reveals nothing about the X° vs. XP status of *ekki* (data due to Gunnar Hrafn Hrafnbjargarson). In (374)b, negation can undergo SF, while neither the main verb nor a PP can, cf. (374)c and (374)d. Without negation, both the main verb and a PP may undergo SF, as in (375)b and (375)c. (*Sem* 'who/that' is the complementizer in C° and the subject is a covert OP in spec-CP; there is thus a 'gap' in spec-FinP.)

(no SF)	Ósló	ðí	verið	a <u>ekki</u>	hafa			sem	Þeir	a.	Ic:	(374)
(Negation)	Ósló	ð í	verið	$a t_1$	hafa	: i _1	ekk	sem	Þeir	b.		
(V ^o)	Ósló	í	t ₁	a <u>ekki</u>	hafa	\cdot ið ₁	ver	sem	*Þeir	c.		
(PP)		ð t ₁	verið	a <u>ekki</u>	hafa	Ósló]₁	[í	sem	*Þeir	d.		
			been	e not	have	o Oslo	in	who	Those			
(no SF)		Ósló	í Ó	verið	hafa			sem	Þeir	a.	Ic:	(375)
(V°)		Ósló	í Ó	t_1	hafa	\cdot ið ₁	ver	sem	Þeir	b.		

A NEG-shifted object, e.g. *engan mat* 'no food', which is obviously an XP, only affects SF of XPs, not X°s. Compare (376)b and c:

(376)Ic: Þeir sem Those who (no SF) hafa engan mat_1 borðað t_1 með skeið a. ... (V^{o}) hafa engan mat₁ t_2 t₁ með skeið b. ...borðað₂ (PP) c. *...[með skeið]₂ hafa engan mat₁ borðað t₁ t₂ food eaten with spoon have no

Higher adverbials, i.e. those that normally precede negation, can undergo Stylistic Fronting because movement of adverbials adjoined to NEGP does not cross NEGP:

(377) Ic: Þeir sem ... Those who

a.		hafa	áreiðanlega	engan	\mathtt{mat}_1	borðað	t ₁	(no SF)
b.	áreiðanlega $_2$	hafa	t ₁	engan	\mathtt{mat}_1	borðað	t ₁	(AdvP)
	without doubt	have		no	food	eaten		

In the next section, I present evidence that *ikke* and *not* are not the only XPs that can not be topicalized and therefore, like island effects, the lack of topicalizability may not be used as conclusive evidence for X° status either. Furthermore, because the enclitic version also raises an island, I will assume that when Neg° is realized as, e.g., English -n't, spec-NegP contains a phonetically empty operator OP.

3.2.4 The Lexical Topic Constraint

Following Rizzi (1997: 287), I assume that the movement of the topic to spec-CP is motivated by the *Topic Criterion*, a constraint on information structure on a par with the *Wh-Criterion* and the *NEG-Criterion* (see chapter 0, section2.4.2; see also the quote from Chomsky, to appear, in (219) in chapter 0):

(378) **The Topic Criterion (TOPCRIT)**

"The topic must be in spec-CP at Spell-Out."

I assume that topicalization is motivated functionally by surface constraints on information structure or on the syntax-pragmatics interface rather than being motivated by an uninterpretable topic feature [uTop] on C^o (which, according to Chomsky, in press, p. 17, "seems superfluous even if feasible"). Formally, however, topicalization is licensed by an EPP-feature on C^o allowing it to have a specifier and requiring it to be filled.

One of the characteristics of a topic is lexical content – it seems intuitive that what the sentence is about has content, contains information. This immediately accounts for the difference in 'topicalizability' between, for example, English *never* and *not*: *Never* literally (as well as etymologically⁴⁹) means *not ever* or \neg *ever*, whereas the operator *not* itself has no lexical meaning, it only means " \neg ". In other words, *never* is [+Neg, +Lex], while *not* is

⁴⁹ Etymologically, *never* is OE: $n\bar{a}fre < ne-\bar{a}fre$ (not-ever); *aldrig* is ON: *aldri-gi* (age-no = never) < *ne aldri-gi* (not age-any = not at any age/time).
[+Neg, -Lex]. Strictly speaking, [Lex] is not a feature just as there is no [Func] feature. It's just shorthand for the presence of lexical features.

I propose that the constraint that regulates whether a language allows topicalization of non-lexical material or not, is an information structure constraint called LEXTOP:

(379) The Lexical Topic Constraint (LEXTOP)

"Spec-CP (or spec-TopicP) must have lexical content."

There are thus two different types of features, i.e. functional and lexical features. The following table is a simple example of the difference between the two (the list of features is not intended to be exhaustive, merely illustrative): 50

Da: En:	ikke not	aldrig	hvilken which	hvem who	en a	hende her
Lexical	<i></i>	Temporal	Entity	Human	<u>u</u>	Female
Functional	+Neg	+Neg	+Wh, -Def	+Wh, -Def	-Def,	Acc, +Def, 3rd,
	U	U	, i	·	3rd,	-Plur, +Fem,
					-Plur, D	-Masc, D

(380) Lexical and Functional Features:

In Danish and English as well as in German, non-lexical negative operators can not be topicalized, whereas in Faroese, Icelandic, Norwegian, and Swedish (and Middle Danish, cf. section 3.2.5 below) both lexical and non-lexical operators can be topic (again, the list is not exhaustive; there are of course other possible negative topics, such as Danish *på ingen måde* 'in no way'):⁵¹

(381) Some (im-)possible negative topics:

	Da	En	Fa	Ge	Ic	MD	No	Sw
[-Lex]	*ikke	*not	ikke	*nicht	ekki	icke	ikke	inte
[+Lex]	aldrig	never	ongantíð	nie	aldrei	aldrig	aldri	aldrig

In a theory with violable constraints such as Optimality Theory (OT; e.g. Grimshaw 1995, Kager 1999, Prince & Smolensky 1993, Vikner 2001*a*, *b*) this difference may be accounted for by differential ranking of constraints (» means "is ranked higher than"):

⁵⁰ Note that the functional feature [+Fem(inine)] and the lexical feature [+Female] are not the same. [Fem] refers to grammatical gender, [Female] to natural gender. For example, the word 'girl' refers to a [+Female] entity. In German, the word for 'girl', *Mädchen*, is [-Fem, -Masc], i.e. neuter; the Danish word for 'girl', *pige*, is [+Fem, +Masc], i.e. common gender.

⁵¹ In Faroese both *ongantið* and *aldri(n)* translate into English *never*.

(382) a. Da, En, and Ge: LEXTOP » TOPCRIT:It's more important that spec-CP is lexical than it is to move the topic to spec-CP.

b. Fa, Ic, No, and Sw: TOPCRIT » LEXTOP:It's more important to move the topic to spec-CP than it is that spec-CP is lexical.

In Danish and English, even though the negative adverbs *ikke* and *not* may be marked [+TOP], they cannot be topicalized. Instead, in English nothing is topicalized (both spec-CP and C^o are empty), whereas in Danish, the subject moves to spec-CP to satisfy the V2 requirement.⁵² The subject becomes the 'default topic' because it is the closest c-commanded constituent.

This difference in topicalization is also (partly) supported by differences in topicalization of other semantically 'light' adverbs. The sentence-medial adverbs in (384) can all occupy the underlined slot in (383) in the respective languages.⁵³ (A '-' in the table indicates that the language has no corresponding single term.)

(383)	a.	Da:	Hun	har	 læst	bogen
	b.	En:	She	has	 read	the book
	с.	Fa:	Hon	hevur	 lisið	bókina
	d.	Ic:	Hún	hefur	 lesið	bókina
	e.	No:	Но	har	 lest	boka
	f.	Sw:	Hon	har	 läst	boken

(384) Sentence medial 'light' adverbs:

Danish	English	Faroese	Icelandic	Norwegian	Swedish
ikke	not	ikki	ekki	ikke	inte
јо	-	jú	nú	јо	ju
også	also	eisini	líka	også	också
da	-	tá	sko	da	då
sikkert	probably	ivaleyst	örugglega	sikkert	säkert
nok	-	nokk	ábyggilega	nok	nog
kun	just	bara	bara	kun	bara
endda	even	enntá	-	%enda	ändå
vistnok	-	helst	eflaust	visstnok	visst
9	5	9	8	8(9)	9

 $^{^{52}}$ In German, the expletive *es* is inserted in spec-CP when there is no topic, see chapter 2, section 2.3.11, footnote 29].

⁵³ Thanks to Peter Svenonius, Kristine Bentzen, Marit Julien, and Janne Bondi Johannessen for information on Norwegian, Kersti Börjars for Swedish, and Gunnar Hrafn Hrafnbjargarson for Icelandic.

Consider next topicalization of these adverbs: ^{54, 55}

(385)	a.	Da:	 har	hun		læst	bogen
	b.	En:	 (has)	she	(has)	read	the book
	с.	Fa:	 hevur	hon		lisið	bókina
	d.	Ic:	 hefur	hún		lesið	bókina
	e.	No:	 har	ho		lest	boka
	f.	Sw:	 har	hon		läst	boken

(386) Fronted 'light' adverbs:

Danish	English	Faroese	Icelandic	Norwegian	Swedish
*ikke	* not	ikki	ekki	ikke	inte
*jo	-	*jú	nú	*j0	*ju
*også	* also	eisini	*líka	*også	%också
*da	-	*tá	*sko	*da	då
*sikkert	% probably	ivaleyst	örugglega	sikkert	säkert
*nok	-	*nokk	ábyggilega	*nok	nog
*kun	* just	*bara	*bara	*kun	* bara
*endda	* even	enntá	-	enda	ändå
*vistnok	-	helst	eflaust	visstnok	visst
0	0(1)	5	5	4	6(7)

There are, of course, other light adverbs that can be fronted in all the languages:^{56, 57}

(Past indicative)

(Past subjunctive)

(i) Ic: a. ?Örugglega hafði ég lesið bókina
 b. Örugglega hefði ég lesið bókina
 Probably had I read book.the

This holds for the past tense. The present subjunctive requires special context and is only licensed in conditionals. Thus, the relative markedness is reversed in the present tense. What is important, however, is that among the three relevant possible combinations of tense and mood, only the past subjunctive is unmarked.

(ii)	Ic:	a.	?Örugglega	hef	ég	lesið	bókina	(Present indicative)
		b.	*Örugglega	hafi	ég	lesið	bókina	(Present Subjunctive)
			Probably	have	I	read	book.the	

⁵⁵ My informants and Faarlund et al. (1997: 814) agree that Norwegian *sikkert* cannot be topicalized. Interestingly, I have found one example in the Bokmål corpus at Tekstlaboratoriet, <u>www.tekstlab.uio.no</u>:

(i) No: <u>Sikkert</u> kunne student-aktørene ha turnert med den Probably could student-actors-the have toured with it på Vestlandsbygdene med stort hell om de kunne on Vestland.districts-the with great luck if they could gi seg tid til slikt. give SELF time to such.

⁵⁶ Both *maybe* and *naturally* are significantly better with a pause/comma intonation:

I have, maybe/naturally, read the book.

⁵⁷ Subject-auxiliary inversion is not obligatory after *måske/kanske* 'perhaps' in any of the Scandinavian languages (cf. e.g. Faarlund et al. 1997: 814, Holmes & Hinchliffe 2003: 496, Lockwood 2002: 154). This is due to the fact that there are two versions of this adverb: One is a 'real' adverb (an XP), and the other is a C^o element.

⁵⁴ In Icelandic, sentences with topicalized *örugglega*, *ábyggilega* and *eflaust* are better in the subjunctive than in the indicative:

(387)	a.	Da:	Hun	har		måske	/	naturl	Ligvis	læst	bc	ogen	
	b.	En:	She	has		?maybe	/	?natura	ally	read	th	ne bo	ook
	с.	Fa:	Hon	hevu	r	kanska	/	natúrl	liga	lisið	bć	kina	1
	d.	Ic:	Hún	hefu	r	kannski	/	náttúi	clega	lesið	bć	kina	1
	e.	No:	Но	har		kanskje	/	naturl	Ligvis	lest	bc	ka	
	f.	Sw:	Hon	har		kanske	/	naturl	Ligvis	läst	bc	ken	
(388)	a.	Da:	Måsl	ke	/	naturlig	/is	har	hun	læs	t	boge	en
	b.	En:	May	be	/	naturally	7		she ha	as rea	d	the	book

c. Fa: Kanska / natúrliga hevur hon lisið bókina
d. Ic: Kannski / náttúrlega hefur hún lesið bókina
e. No: Kanskje / naturligvis har ho lest boka
f. Sw: Kanske / naturligvis har hon läst boken

The point is that topicalization of adverbs is significantly more restricted in Danish and English than in the other languages in question. None of the semantically light adverbs in (386) can be fronted in Danish and English, whereas it is possible to varying degrees in the other languages.

The fact that not all of these adverbials behave the same within each language suggests that some other constraint or constraints are involved besides LEXTOP and/or that [+/-Lex] is not binary: A certain amount of meaning or number of lexical features is necessary to license topicalization, such as e.g. [+Temporal] or [+Spatial], compare (367) and (368) above.

One might also argue that the adverbials have different structural positions in the clause and that only higher ones may be topicalized. This is not borne out. In the partial structure in (389) below, the adverbs marked with '*' are ones that can not be fronted in any of the languages; those with ' \checkmark ' are the ones that can be fronted in all of the languages, and '%' indicates that the adverb can be fronted in some but not all of the languages. (The adverbs are listed in the sequential order in which they may naturally occur, at least in Danish; see (386) for translations):

Only the former induces inversion. The etymology of *måske/kanske* is *må/kan* 'may/can' + *ske* 'happen', exactly as the English *maybe*. Interestingly, the difference between the adverb and the C^o element has yet another consequence in Icelandic. When *kannski* is in C^o (no inversion), the verb is in the subjunctive, whereas when *kannski* is in spec-CP (with inversion), the verb is in the indicative. In Swedish, *kanske* may also immediately follow the subject, e.g. *han kanske inte vill göra det*, i.e. *kanske* is in C^o and the subject in spec-CP.



Aldrig 'never' is in spec-NegP; this is supported by the fact that *ikke* and *aldrig* are in complementary distribution and also by the fact that they both license sentential negation and NPIs.

The question is not whether a language allows fronting of adverbials in general or not, because that is licensed in all the languages. The same goes for operators, because all the languages allow topicalization of (some version of) the operator *never*. The important distinction is whether semantically light adverbs may be topicalized or not

Below I show how this can be derived from the relative ranking of LEXTOP and TOPCRIT and their interaction with one additional constraint on operators and scope.

3.2.5 The Development in Danish

Jespersen's cycle (1917) (that is, the negative marker's oscillation between free word and affix) offers support for the XP status of Danish *ikke* as well as for negation in the other Scandinavian languages and English. The original negative marker *ni* was reduced to a clitic *ne*- and subsequently another marker was introduced, namely *ekki*, which started out as a negative polarity item (NPI). At some point *ne*- disappears and the adverbial *ekki* is used alone to mark negation.⁵⁸

(390) $ni V > ne-V ekki_{NPI} > V ekki_{NEG} > V icke_{NEG} > V ikke_{NEG}$

⁵⁸ The former status of the negative marker as an NPI receives some support from the etymology of Danish *ikke* and English *not* (both reminiscent of the French *ne pas*, literally 'not a step'):

⁽i) Da: *ikke* < OD *ekki* < ON *ekki*, neuter of *engi* < *ne einn-gi* / *ne eitt-gi* ('not one-at.all')

⁽ii) En: *not* < ME weak variant of *naught* < ME, OE *nauht*, *nāwith* ($n\bar{a}$ 'no' + *with* 'thing')

Interestingly, non-standard northern dialects of English still have a distinction between *owt/aught* 'anything' (NPI) and *nowt/naught* 'nothing' (cf. <u>http://dictionary.cambridge.org</u>).

In fact, it appears that there are two developments: one for prose and another for poetry; in the former *ekki* is the preferred negation marker whereas in the latter, the enclitic -at is preferred (see also Hellesnes & Høyland 1974: 27); *-at* and *ekki* appear to be in more or less complementary distribution. Jespersen (1917: 8) notes that "[t]his form, with -at or -a as the negative element, is frequent enough in poetry; in prose, however, another way of strengthening the negative was preferred as having "more body", namely by means of of *eigi* or *ekki* after the verb." This "strengthening" suggests that *ekki* started out as a negative polarity item (NPI). Negation was already expressed by the proclitic *ne* and to begin with *ekki* did not express negation on its own but only served to 'strengthen' the negation, in the same way as the Modern Danish NPI *overhovedet* 'at all'.

(391) a. Prose: Ne V > Ne-V ekki_{NPI} > V ekki_{NEG} b. Poetry: Ne V > Ne-V at_{NPI} > V- at_{NEG}

As Eythórsson (2002) states in his analysis of the enclitic -at:

(392) Occurring almost exclusively in Old Icelandic texts, -a/-at is very rare in Old Norwegian documents, where it is not found at all in literary texts. [...] In Icelandic itself, -a/-at was not long-lived. [...] In prose it only occurs in early Old Icelandic documents such as the Stockholm (Icelandic) Book of Homilies (early 12th century) and the Grágás law code (mid-13th century). It is absent from the bulk of Old Icelandic prose of the 12th-14th centuries, where sentential negation is expressed by adverbs like eigi (and its shortened form ei), as well as þeygi and ekki (all meaning 'not'). (Eythórsson 2002: 195-196)

I shall focus on the development in the prose system, i.e. the *ekki* version, and disregard the poetic version with *-at*.

Topicalized negation is found in Proto-Norse which, for reasons that will be made clear shortly, I label Proto-Norse 1 (PrN1, Da. *Urnordisk*, c. 200-800) runic inscriptions (I take *ni*'s to be phonological cliticization of -s in C^o to *ni* in spec-CP):

(393) PrN1: <u>ni</u>'s solu sot uk ni sakse stAin skorin not-is sun sought and not knife stone cut "It is not hit by the sun and the stone is not cut with a knife." (ca. 700, The Eggium Stone in Norway, Krause 1971: 143) With *ni* occupying spec-CP, topicalization of another constituent is blocked (the structures only include arrows for movements directly relevant to negation and topicalization):



I propose that this obligatory movement to spec-CP of the negative operator is motivated by the highly ranked constraint *Operators in Scope* (Baković 1998: 39, (6a), Ackema & Neeleman 1998: 17, (5)):

(395) **Operators in Scope (OPSC)**

Operators must be in scope positions, i.e. c-command the clause. "OPs must be in spec-CP"

With OPSC ranked higher than LEXTOP and TOPCRIT, it is more important to have the operator in spec-CP than to move a potential topic and to make sure that spec-CP is lexical.

(396) Proto-Norse 1: OPSC » LEXTOP, TOPCRIT

The constraint hierarchy and how it applies to competing (partial) structures is illustrated in the tableau in (397) below. In the (a) competition (i.e. (a1) vs. (a2)), the choice is between fronting the operator OP (a1) and fronting the constituent marked as topic (a2). In the (b) competition, ((b1) vs. (b2)), the choice is between fronting an operator (or a semantically light element, such as an NPI) marked for topic (b1) and making the subject default topic and leave

the operator OP in situ (b2). Examples of the candidates are given (using Modern Danish words) in (398) below. The gray shading indicates that potential violations are irrelevant because the competition has been resolved by violations of higher ranking constraints. (Constraints to the left are ranked higher than those to the right; researcher marks the optimal candidates and * marks the suboptimal/ungrammatical ones. Absence of vertical lines between constraints indicates that ranking is non-crucial.)

(397)	Proto-Norse	1
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		OPSC	LEXTOP	TOPCRIT
ß	a1. [CP OP C° [FinP Subj Fin° [NegP tOP]]]		*	-
*	a2. [CP Topic C° [FinP Subj Fin° [NegP OP]]]	*!		
ß	b1. [CP OP _{Topic} C° [FinP Subj Fin° [NegP toP]]]		*	-
*	b2. [CP Subj C° [FinP tSubj Finº [NegP OPTopic]]]	*!		*

(398)	a1:	Ikke	har	vi		drukket $øl_{Topic}$	= (393)
	a2:	$\operatorname{Øl}_{\operatorname{Topic}}$	har	vi	ikke	drukket	= (402)
		Beer	have	we	not	drunk	
		"Beer v	we hav	en't	t been	drinking."	

b1:	${\tt Ikke_{\tt Topic}}$	har vi		drukket	øl	=(402)					
b2:	Vi	har	$ikke_{Topic}$	drukket	øl						
	We	have	not	drunk	beer						
	"We have not been drinking beer."										

According to Eythórsson (2002: 193), the negative marker *ne* (*ni*) is rare and not productive in Old Norse and when it is there, it displays the characteristics of an archaism (base-generated on the verb). Moreover, in Old Norse, the verb with the proclitic *ne* never occurs sentence-initially.

This (together with learnability and reanalysis) suggests a hypothetical intermediate stage between Proto-Norse and Old Norse, Proto-Norse 2 (PrN2), where ne/ni has been reduced to a proclitic head. Being an X°, it can not move to spec-CP and therefore topicalization is not blocked. I assume that the NPI adverb *ekki* is merged as a VP adverb, i.e., an adjunct of vP (in later stages where *ekki* has the status of true negation it is attracted to spec-NegP to check EPP on Neg°, as argued in chapter 0, section 2.3.11):



The semantically light NPI *ekki*, as well as the phonetically empty negative operator OP in spec-NegP, cannot be topicalized, which can be accounted for by ranking LEXTOP above OPSC and TOPCRIT:

(400) Proto-Norse 2: LEXTOP » OPSC, TOPCRIT

(401) Proto-Norse 2

	LEXTOP	OPSC	TOPCRIT
* a1. [CP OP C° [FinP Subj Fin° [NegP tOP]]] *!		
a2. [CP Topic C° [FinP Subj Fin° [NegP OF	?]]]	*	
* b1. [CP OP _{Topic} C° [FinP Subj Fin° [NegP to)P]]] * !		
▶ b2. [_{CP} Subj C ^o [_{FinP} t _{Subj} Fin ^o [_{NegP} OP _{To}	opic]]]	*	*

It is more important to keep spec-CP lexical, as in candidates (a2) and (b2), than to have the empty operator in a scope position, as in candidate (a1), or to move a non-lexical topic, candidate (b1). When the operator OP is marked as topic, as in the competition between (b1) and (b2), LEXTOP bars topicalization and the subject becomes the 'default topic' and moves to spec-CP, i.e. candidate (b2) is optimal.

In short, two things separate Proto-Norse 2 from Proto-Norse 1. First, negation *ne* changes from being realized as an adverbial in spec-NegP to be being realized as an enclitic Neg^o. The overt negation marker is therefore not subject to OPSC which only applies to

operators, that is, XPs. Second, the constraints are reranking such that LEXTOP now outranks both TOPCRIT and OPSC (whose rankings with respect to each other is not crucial here).

According to Iversen (1973: 158), in Old Norse (ON, c. 800-1100), topicalization of negation had developed into being quite common – i.e. optional, not obligatory. The same pattern is found in Old Danish (OD, c. 1100-1350), and Middle Danish (MD, c. 1350-1500):

(402) ON: <u>Ekki</u> er þat várt ættnafn Not is that our family-name (Iversen 1973: 158)

(403) OD: <u>Ekki</u> kan umbotzman mere for siin ret fangæ Not can ombudsman more for his right receive (1241, Jyske Lov, Udaler & Wellejus 1968: 90)

(404) MD: Icke tror ieg ath Gud kunde bliffue mand Not think I that God could become man (1534, Karl Magnus' Krønike, Ruus 2001)

The change from Proto-Norse 2 to Old Norse is also two-sided: a change in negation and a constraint reranking. **First**, negation changes from Neg^o back to spec-NegP. *Ne* has disappeared and *ekki* has changed status from NPI to negative operator. Old Danish and Middle Danish, as well as all the other Scandinavian languages except Modern Danish, behave in the same way as Old Norse in allowing topicalization of the negative operator. The **second** and independent change is constraint reranking: TOPCRIT is now ranked above LEXTOP which in turn is ranked above OPSC.

(405) Old Norse (and descendants): TOPCRIT » LEXTOP » OPSC

It is more important to move any topic, lexical (a2) or non-lexical (b1), than it is to make sure that spec-CP is lexical (b2) or to move the operator into spec-CP (a1):

	TOPCRIT	LEXTOP	OPSC
* a1. [CP OP C° [FinP Subj Fin° [NegP tOP]]]		*!	
a2. [CP Topic C ^o [FinP Subj Fin ^o [NegP OP]]]			*
^{ISS} b1. [_{CP} OP _{Topic} C ^o [_{FinP} Subj Fin ^o [_{NegP} t _{OP}]]]		*	
* b2. [CP Subj C° [FinP t _{Subj} Fin° [NegP OP _{Topic}]]]	*!		*

(406) Old Norse and descendants (except Modern Danish)

This is also illustrated in the structure below (the dotted arrow and multiple copies of the moving element indicate optional movement):



The constituent marked for topic, be it lexically light or not, moves to spec-CP.⁵⁹

Consider next Modern Danish, which does not allow topicalization of the negative operator:

⁵⁹ There is another important difference, disregarded here, between Old Norse and the descendant Scandinavian languages on the one hand, and Modern Danish and English on the other. The former (with Danish at least up until Middle Danish) allow (stylistically marked) V1 declarative main clauses in certain contexts, primarily in written narrative texts, a phenomenon know as *Narrative Inversion* (NI). If NI is analyzed as topic-drop (perhaps of something like 'and then'), such structures probably contain an empty operator OP in spec-CP. This OP, being an operator and topic, is subject to OPSC, LEXTOP and TOPCRIT; in fact it violates LEXTOP as it contains only the contextual (co)reference. Some other highly ranked constraint or constraints render such V1 declaratives grammatical. (Alternatively, the finite verb, or some property of it, is itself the topic.) It is interesting to note that Danish and English which are restricted in the topicalization of 'light' adverbials are also the languages that disallow NI. German is a counter example as it disallows topicalization of *nicht* but allows NI. See also footnote 61.



The difference between Modern Danish and Old Norse (and its other descendants) is that in Modern Danish, LEXTOP has highest priority, as in Proto-Norse 2, which makes it most important that spec-CP has lexical content. After that, moving the topic has priority over moving the operator to spec-CP:

(409) Modern Danish: LEXTOP » TOPCRIT, OPSC

(410)	Modern Danish
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		LEXTOP	TOPCRIT	OPSC
*	a1. [CP OP C° [FinP Subj Fin° [NegP tOP]]]	*!		-
6	a2. [CP Topic C° [FinP Subj Fin° [NegP OP]]]			*
*	b1. [CP OP _{Topic} C ^o [FinP Subj Fin ^o [NegP toP]]]	*!		-
R ²	b2. [CP Subj C° [FinP tSubj Fin° [NegP OPTopic]]]		*	*

As in Proto-Norse 2, when the operator OP is marked for topic (candidate (b1), LEXTOP bars it from moving to spec-CP and the subject becomes the 'default topic', as in candidate (b2). There is, however, an important difference between Proto-Norse 2 and Modern Danish: In the former, the overt negation marker is the proclitic Neg^o *ne*-, whereas in the latter, it's the AdvP *ikke* in spec-NegP.

That the differences between the stages are rather minimal becomes clearer once the hierarchies are set up in a box-diagram. Vertical lines mean "is ranked higher than", i.e., the same as "»". 'Missing' vertical lines indicate that rankings are non-crucial, i.e. the same as

commas in the constraint hierarchies above. ON+ is short for Old Norse, Old Danish, Middle Danish, Faroese, Icelandic, Norwegian, and Swedish.



(411) Diachronic Change and Parametric Variation:

The syntactic change in grammaticality of NEG-topicalization, but not the cyclic change between spec-NegP and Neg^o, is accounted for by the movement of a single constraint. In fact, it seems that Jespersen's cycle and NEG-topicalization has little or nothing to do with each other, except that XP status is a necessary (but not sufficient) prerequisite for topicalization:



(412) Summary of the morphosyntactic developments (O=Da, $\diamond=En$, $\Box=ON+$):

3.2.6 The Development in English

The morphosyntactic development in English is in a number of ways parallel to the one in Danish. For expository reasons I begin with the summary:





Note that the rankings for Proto-, Old, and Middle English are the same as the one for Proto-Norse 1, and that Early Modern and Modern English are the same as Modern Danish.

Jespersen's cycle for English looks as follows:

(414) no $V > ne V > ne-V na_{NPI} > V not_{NEG}$

Kemenade (2000: 63) divides the language in *Beowulf* into two stages, namely 8th century Old English, for which I use the term Proto-English, and Early and Later Old English, which I merely call Old English.



Beowulf, which constitutes the oldest written material in English, is included in spite of the fact that it is poetry, which may be subject to other constraints and rules of style than

prose. However, it is scientifically more interesting to see whether these earliest stages, regardless of style, can be accounted for by the same general analysis as the rest of the stages of English.

In Proto-English (PrE, c. 450-800), which is not a V2 language, negation is marked with the sentence initial *no/ne* (I ignore OV word order phenomena and the exact position of the verb):⁶⁰

(416) PrE: No he wiht fram me flodypum feor fleotan Not he thing from me waves-DAT.PL far swim meahte, hrapor on holme; <u>no</u> ic fram him wolde. could, quicker in water; not I from him wanted

> "In no way could he swim far from me on the waves of the flood, more quickly on the sea; I would not consent to leave him."

> > (c. 750, *Beowulf*, 541-543, Klaeber 1922; translation: Kemenade 2000: 61, (11a))

(417) PrE: $N\bar{O}$ ic on niht gefrægn under heofones hwealf Not I of night heard under heaven.GEN vault

> heardran feohtan, <u>nē</u> on ēgstrēamum earmran mannon; harder fight not on ocean.DAT more-miserable man.ACC.SG

"Of night-fought battles ne'er heard I a harder 'neath heaven's dome, or adrift on the deep a more desolate man!"

(ca. 750, *Beowulf*, 575-577, Klaeber 1922; translation: Gummere 1910)

 $^{^{60}}$ According to Susan Pintzuk (p.c.), it is not entirely clear that *no* is topicalized. In Old English poetry (not prose), unstressed elements cluster at the beginning of the clause (in V2 contexts only one precedes the finite verb). The adverb *no* may just be in the position where unstressed adverbs normally occur.



It's more important to have the operator in spec-CP than to make sure that spec-CP is lexical and to move a potential topic (note that this is the same ranking as in Proto-Norse 1, see (396) above):

(419) Proto-English: OPSC » LEXTOP, TOPCRIT

	OPSC	LEXTOP	TOPCRIT
al. [CP OP C° [FinP Subj Fin° [NegP tOP]]]		*	-
* a2. [CP Topic C ^o [FinP Subj Fin ^o [NegP OP]]]	*!		
▶ b1. [CP OP _{Topic} C ^o [FinP Subj Fin ^o [NegP toP]]]		*	-
* b2. [CP C° [FinP Subj Fin° [NegP OP Topic]]]	*!		*

(420) Proto-English

In (b2), the subject stays in spec-FinP rather than move to spec-CP. PrE is not a V2 language so CP need not be filled. As there is no spec-CP, LEXTOP is vacuously satisfied: there is nothing there to violate it. C^o is presumably still projected e.g. to host information related to force.

Old English (OE, c. 800-1100) is a V2 language and sentential negation is realized as the sentence initial *ne* immediately followed by the finite verb:

 (421) OE: <u>Ne</u> seah ic elpeodige pus manige men modiglicran Not see I all-people thus many men brave
 "Among all the peoples, I haven't seen so many brave men."

(c. 750, Beowulf, 336-337, Klaeber 1922)

(422) OE: <u>Ne</u> forealdige peos hond æfre. Not grow.old this hand ever "This hand never grows old."

(ca. 890, Bede's Ecclesiastical History of the English People, 4, Miller 1959)



As was the case with Proto-English, in Old English it is more important to have the operator in spec-CP than to make sure that spec-CP is lexical and to move a potential topic (the difference between the two is the setting of the 'V2 parameter'). The ranking is thus the same as in Proto-English, as therefore the tableau in (420) also holds for Old English.

(424) Old English: OPSC » LEXTOP, TOPCRIT

In Middle English (ME, c. 1100-1450), which is a V2 language, at least with pronominal subjects⁶¹, the sentence initial *ne* has been weakened and it is now supported by the sentence medial NPI *na* (adjoined to *v*P, cf. chapter 0, section 2.3.11) or by some other negative element (such as a negative quantifier phrase). *Ælfric* is normally classified as Old English but when it comes to negation, it behaves more like Middle English:

⁶¹ Unlike the Scandinavian languages except Modern Danish, Old English and most likely Middle English do not have Narrative Inversion. According to Susan Pintzuk (p.c.), there are very few Old English examples of nonnegative V1 and these sentences do not appear to serve to advance the narration as Scandinavian Narrative Inversion does. Instead, for narrative sequences *tha/thonne* 'then' is used sentence initially (in spec-CP) followed by the finite verb in C^o (V2) and the (non-pronominal) subject in third position. See also footnote 59.

(425) ME: <u>Ne</u> hate ic eow <u>na</u> beowan Not call I you not slave
"I don't call you servants." (c. 1000, *Ælfric's Lives of Saints*, 84, Skeat 1966)

The following example shows, however, that the transition from *ne* to *ne...na* was not complete in *Ælfric*:

(426) ME: Se halga wer him cwæð to, <u>Ne</u> hoga þu embe þæt The holy man him said to not think you about that "The holy man said to him: Don't you think about that."

(ca. 1000, *Ælfric's Lives of Saints*, 416, Skeat 1966)

In later stages of Middle English the pattern with sentence-initial negation (and negative concord) still holds. The NPI *na* has been replaced with the NPI *nou3t*. *Ne* is clearly a clitic as it always immediately precedes the verb which is evident from the following imperative examples. Imperatives are verb initial and do not have available specifiers for topics:

(427) ME: <u>Ne</u> chaste 3e <u>nan</u> swich mon <u>neauer</u> on oðerwise NEG chasten.IMP you any such man never in otherwise "Don't ever chasten any such man otherwise."

(ca. 1225, Ancrene Riwle, Dobson 1972: 76)

(428) ME: <u>Ne</u> wende 3e <u>neauer</u> õe rug mine leoue sustren. NEG turn.IMP you never the back my dear sisters "You, my dear sisters, don't you ever turn your backs."

(ca. 1225, Ancrene Riwle, Dobson 1972: 193)

Curiously, *ne* can also be used as a complementizer (equivalent to Modern English *nor* and Icelandic and Old Norse $n\acute{e}$), as in (429) and (430) below. Note also that a pronominal subject, as in (429), occupy a position above the NPI, namely spec-FinP between the complementizer and the finite verb, while a full DP subject, as in (430), occupy a specifier below the NPI (adjoined to *v*P), which must then be spec-*v*P (see also Fischer et al. 2000: 126):

 (429) ME: <u>Ne</u> he <u>ne</u> turned <u>nou3t</u> his face oway fram me Nor he NEG turned not his face away from me "Nor did he turn his face away from me." (ca. 1350, The Earliest Complete English Prose Psalter, Bülbring 1891: 25)

(430) ME: <u>Ne</u> <u>ne</u> schorne <u>nou3t</u> myn enemis me Nor NEG scorn not my enemy me
"And neither does my enemy scorn me."
(ca. 1350, The Earliest Complete English Prose Psalter, Bülbring 1891: 27)

(431) $[_{CP} Ne [_{FinP} (Pron-Subj) ne-Verb_{Fin} ... [_{\nu P} nou3t_{NPI} [_{\nu P} (DP-Subj) ... Obj]]]]$

To keep the representations as parallel as possible, the subject is in Spec-FinP, hence a pronoun, in the structure in (433) below:

The semantically light NPI *na/nou3t* cannot be topicalized. It is more important to keep spec-CP lexical than to move a non-lexical topic. Furthermore, to bar topicalization of the empty operator OP in spec-NegP (see also footnote 59 and 61), LEXTOP must outrank OPSC; recall that OPSC does not apply the Neg^o:

(432) Middle English: LEXTOP » TOPCRIT, OPSC



(434) Middle English (=Da)

		LEXTOP	TOPCRIT	OpSc
*	a1. [CP OP C° [FinP Subj Fin° [NegP tOP]]]	*!		-
5	a2. [CP Topic C° [FinP Subj Fin° [NegP OP]]]			*
*	b1. [CP OP _{Topic} C ^o [FinP Subj Fin ^o [NegP toP]]]	*!		-
ß	b2. [CP Subj C° [FinP tSubj Fin° [NegP OPTopic]]]		*	*

The difference between Old and Middle English is two-sided: **one**, negation changes category from spec-NegP to Neg^o; **two**, spec-CP has to be lexical and therefore LEXTOP has to have the highest ranking.

Early Modern English (or Early New English, ENE, c. 1450-1700; 'Shakespeare English') is not a V2 language (or rather, it's 'residual V2'; see Fischer et al. 2000: 132). The negative marker is *not* in spec-NegP and it can not be topicalized.

(435) ENE: So foul and fair a day I have <u>not</u> seen.

(1606, *Macbeth*, scene 3, William Shakespeare)

The relevant change from Middle English to Early Modern English is that negation changes back from Neg^o to spec-NegP. The constraint hierarchy is the same as in Middle English. Hence, the tableau in (434) above also holds for Early Modern English:

(436) Early Modern English: LEXTOP » TOPCRIT, OPSC

It's more important to move the topic to spec-CP and to make sure that it's lexical than it is to move the operator to a scope position.



Finally, the rise of *do* insertion during the 17th century, first in questions and later also with negation (cf. Rohrbacher 1999: 166), leads to Modern English where lexical verbs no longer move to Fin^o. With regard to category and topicalizability, however, there is no difference between Early Modern and Modern English. The ranking of the constraints is identical which means that the tableau in (434) above covers the stages from Middle English over Early New English up to and including Modern English.



3.2.7 Summary and Conclusions

I have argued that the negation markers *ikke* and *not* in Danish and English, respectively, can be analyzed as XPs rather than X^{o} and that the fact they can not be topicalized is due to their semantic 'lightness' – a property also found with other adverbials. This makes the negative operators parallel in all the Scandinavian languages and English, some of which have two versions, a clitic and an XP.

The synchronic variation in whether the negative operator can be topicalized or not, is accounted for by different rankings of the *Lexical Topic Constraint* (LEXTOP) and the *Topic Criterion* (TOPCRIT).

The diachronic development from obligatory clause-initial negation in Proto-Norse and Proto-English to the present non-topicalizability of the negation markers is accounted for by two mechanisms: 1) categorical oscillation, known as *Jespersen's cycle*, and 2) the relative ranking of one more constraint, namely, *Operators in Scope* (OpSc). These two mechanisms are independent: XP-status is a necessary but not sufficient prerequisite for topicalization.

It's important to note that the historical change is not a semantic weakening of the negation such that it becomes lighter over time. Rather, it is due to a change in priorities among surface constraints on information structure which is orthogonal to morphological change (Jespersen's cycle).

3.3 Negation and Infinitives: Head Movement

3.3.1 Introduction

The point of this chapter is to show that the word order variation observed in infinitives between the infinitive marker and negation (and other adverbials) is not caused by movement of the sentential negation, nor is it caused by different merge positions of various adverbs. What moves is the infinitive marker which I shall argue is merged as the topmost verbal head, v_{INF}^{o} , in the VP-domain. Movement of the infinitive marker is driven by φ -feature checking in Icelandic and Swedish while in the other Scandinavian languages and English, this movement is optional and presumably motivated by scope or information structure. The Icelandic infinitive marker is special (compared to the other languages in question) in that it can incorporate the infinitive verb and move as a complex head.

Furthermore, arguing that there are two types of infinitives, [+/-Inf], which are realized and/or used differently across languages. In Germanic (or at least in the Germanic languages discussed here), the split is +/- infinitive marker, e.g. English *to*; in Hebrew, the split is +/- finiteness; in European Portuguese, the split is +/- subject agreement). This suggests a typology of verb features which in turns imply structural projections. Ultimately, this is an argument for IP=FinP.

3.3.2 Base-position of the Infinitive Marker

Within the VP-domain, V°-to- v° movement is obligatory (as has been assumed throughout), at least with ditransitive verbs in order to precede the indirect object. I will assume that the verb always raises to v° , even in mono- and intransitive verbs though it is string-vacuous in such cases (as spec-VP, the base-position of an indirect object between V° and v° , is empty or, rather, not projected).⁶² Throughout I use vP for the light verb projection regardless of transitivity (thus disregarding differences between $v^{*\circ}$ and v°):

(439) Da: a. *at nogen give noget
b. at give_v nogen t_v noget
(440) En: a. *to someone give something
b. to give_v someone t_v something

⁶² Exceptions to obligatory V°-to- v° movement may be structures that don't have an external argument, namely, passives and unaccusatives both of which have raising to subject, which can be argued to lack vP altogether. On the other hand, if v° is the verbalizing head like n° is the nominalizer (Chomsky 2004: 122), there is always a v° in clauses with verbs, but not in small clauses.

(441) Obligatory V°-to-v° movement:



The question is then where the infinitive marker is merged or base-generated (I use the two terms as synonyms). As the verb never moves across the infinitive marker and because the infinitive marker cannot be topicalized, it is reasonable to assume the infinitive marker to be a head. There are (at least) four logically possible answers: V^o, v^o , T^o, or a functional F^o.

If the infinitive marker, e.g. English *to*, is first merged with the verb V, forming a complex head [*to* [V^o]] which is then inserted / base-generated in V^o, the unwanted process of excorporation would subsequently be necessary. After the obligatory movement in (441), *to* would have to excorporate from the verb and move to T^o to precede adverbials like for example *boldly* in the famous phrase from Star Trek:

(442) To **boldly** go where no man has gone before.

Therefore, I reject and disregard this analysis.

If the infinitive marker is base-generated in v° , excorporation would again be necessary. The complex head [to [V^o]] that results from the obligatory V^o-to- v° movement would have to be split up again in order to get the split infinitive in (442). Hence, this analysis is also rejected.

Base-generating the infinitive marker as T^o is also problematic, because examples where *to* follows VP-adverbials, as in example (443) below, would have to involve rightward movement or lowering of *to* from T^o to v^{o} across the VP-adverbial adjoined to vP.

(443) The snails were beginning **slowly** to move in all directions

This analysis is also disregarded.

In the analysis adopted here, the infinitive marker is base-generated in a functional projection FP above vP (and auxiliary VP-shells) but below TP as it may follow VP-adverbials, which are then adjoined to FP. This analysis raises none of the problems associated with excorporation and lowering. Optional movement (indicated with a dotted arrow) from the base-position in F° to T° to precede VP-adverbials is illustrated in (447) below.

It is tempting to assume that F^o is the same as Asp(ect)P, but closer inspection shows that the assumption is wrong. For example, [+/-Perf(ect)] is independent of [+/-Inf(initive)] and vice versa:

		[Inf]	[Perf]
a.	To go to bed early	+	-
b.	To have gone to bed early	+	+
c.	I went to bed early	-	-
d.	I have gone to bed early	-	+

(444) [Infinitiv	e] and	[Perfect]
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Furthermore, aspect may be realized as an auxiliary verb (but may also be realized as inflection on the main verb as e.g. [+/-Perf] in Biblical Hebrew) which may also be infinitival, as in the [+Inf, +Perf] example in (444)b above and in the following examples of Prog(ressive) aspect:

(445) [Infinitive] and [Progressive]

		[Inf]	[Prog]
a.	He promised [to mow the lawn when she came back]	+	-
b.	He promised [to be mowing the lawn when she came back]	+	+
c.	He mowed the lawn when she came back	-	-
d.	He was mowing the lawn when she came back	-	+

At first sight, the [Inf] feature seems to logically presuppose a [-Fin(ite)] feature such that the verb is [-Fin, +Inf]. At some point in the derivation the [-Fin] feature (which is merged above TP) probes for a matching feature and agrees with the [Inf] head. However, this is not entirely unproblematic because Finnish infinitives are inflected for tense. The presupposition is apparent rather than logically necessary and appears to be subject to parametric variation. The point is rather that the head carrying the [+Fin] feature, Fin^o, selects TP, as finite clauses are always tensed, whereas tensed clauses are not always finite. I return to this in section 3.3.5.3 below.

Following Chomsky (2001) in assuming only CP, TP, and vP unless empirical evidence motivates otherwise, F° (or Inf(initive)P) may also be analyzed as a verbal head v_{INF} ° which selects a vP/v*P/VP (see also Ernst 1992: 129 and Pullum 1982: 197). Analyzing FP as v_{INF} P captures the facts that (a) the infinitive marker is verbal and (b) [Inf] is a functional category rather than a lexical one: it's an extended projection of the lexical verb. The latter is supported by the fact that for example in Biblical Hebrew the infinitive marker is realized as inflection on the verb, not as a word.

The infinitive marker is merged as the head v_{INF}° selecting the vP housing the PRO subject:



In a phase-based approach (e.g. Chomsky 2001), $v_{INF}P$ is the strong phase boundary. Under the PIC, a vP external probe cannot see beyond v_{INF}° . Therefore, elements that are goals for probes outside the vP phase must be outside the c-command domain of v_{INF}° . I assume that a vP headed by an infinitive ($[v^{\circ}+V^{\circ}]$) is not a strong phase and therefore movement to the phase edge does not move through the infinitival vP; instead, movement is directly to spec $v_{INF}P$ or v_{INF}° . (In other words, additional EPP-features are not inserted on infinitival v° as Last Resort as is the case with strong vPs. Taken a bit further, it could be taken to suggest that the PRO subject is merged as spec- $v_{INF}P$ rather than as (the lower) spec-v(*)P. The issue is not crucial for the present analysis and I assume the subject to be merged as spec-v(*)P.)

As mentioned above, I assume the projection immediately above NegP to be Fin(iteness)P, not TP which is situated between NegP and the VP-domain. (This has in fact been assumed throughout.) As tense is dependent on finiteness (+Fin \rightarrow +/-Past, -Fin \rightarrow 0Past), it makes sense to assume that TP is selected by the head carrying the [Fin] feature. In section 3.3.5.3, I shall argue that [+/-Fin] is distinct from [+/-Inf], such that the former projects FinP and selects TP (or NegP/PoIP), the latter projects $v_{INF}P$ and selects $vP/v^*P/VP$.

The tree in (447) illustrates the base-position and optional movement (indicated with a dotted arrow) of the infinitive marker; I'm leaving aside the movement of PRO to the phase

edge, spec- $v_{INF}P$, and also the movement of negation form the base-position as adjoined to $v_{INF}P$, the topmost vP to spec-NegP (cf. chapter 2, section 2.3.11). In all the examples, negation has sentential scope and movement to spec-NegP is presupposed.



3.3.3 Movement of the Infinitive Marker

3.3.3.1 Danish

In Danish, the infinitive marker *at* optionally moves to T^o where it precedes left-adjoined VPadverbials like *bare* 'just', as in (448)b. It can not move to Fin^o as it can not precede negation, cf. (448)c (at least this is very marked and significantly worse than (448)b):⁶³

 $^{^{63}}$ The Danish word *til* 'to' is a preposition and should not be confused with the infinitive marker *at* which is also glossed as 'to'.

(448) Da. Vi overtalte dem til ... We persuaded them to

a.		ikke		bare	at	<u>prøve</u>	igen
b.		ikke	at	bare		<u>prøve</u>	igen
с.	?? <u>at</u>	ikke		bare		prøve	igen
	to	not		just		try	again

(449) Da: Vi er for glade for klubben til bare at give slip. We are too happy for club-the to just to give slip "We are too fond of the club to just let it go." (Korpus2000)

(450) Da: Mest for <u>at</u> bare <u>holde</u> folket underrettet ... Mostly for to just hold people-the informed "Mostly just to keep people informed." (Korpus2000)

The adverb *bare* 'just' is not the best indicator, because it has properties that other adverbials do not have, namely, it can move with the verb under V2, e.g. *hun bare skriger og skriger* 'she just screams and screams' and may thus exceptionally intervene between the subject and the finite verb.

A corpus search in Korpus90/2000 (using VISL's web interface, http://visl.sdu.dk/) for adverb–at–verb_{Inf}, corresponding to (448)a, gave 13818 results. The following table shows a subset of the adverbials and the corresponding number of examples: ^{64, 65}

(451)

Adverb	Examples
straks	98
ligefrem	19
virkelig	47
bare	319
fortsat	128
hurtigere	5
både	160
også	785
ofte	4
ikke	3502

⁶⁴ I actually used the following mask: preposition–at-adverb–verb_{Inf}. The preposition ensures that examples with the matrix verb in V2 and the adverb belonging to the matrix clause are excluded.

⁶⁵ Examples (452)-(466) are from Korpus2000.

sum	5067
	0001

(452) Da: ...og opfordrer politikerne til **straks** <u>at gennemtvinge</u> and encourages politicians to immediately to force.through

> en ny afstemning a new voting

(453) Da: ...men ligefrem <u>at ville</u> ligne en 17-årig, når man er 40, but downright to want look.like a 17-year.old when one is 40 syntes jeg er meget urealistisk think I is very unrealistic
(454) Da: ...egenskaber som kan hjælpe dig til virkelig <u>at være</u> dig selv qualities that can help you to really be you self
i denne svære situation

in this difficult situation

A search for examples of the *at*-adverb-verb_{Inf} word order, corresponding to (448)b, gave 99 results, a subset of which is listed in the table in (455):

(455)

Adverb	Examples
straks	1
ligefrem	2
virkelig	1
bare	2
fortsat	0
hurtigere	1
både	15
også	3
ofte	3
ikke	7
sum	35

(456) Da: Samtidig kan man lægge nogle gnaveben eller At.the.same.time can one put some gnawing.bones or

> Tyggelegetøj ind i buret for <u>at</u> **hurtigere** <u>nå</u> et resultat chewing.toys in-to cage-the for to quicker get a result

(457) Da: Der åbnes mulighed for <u>at</u> straks <u>afskrive</u> There opened possibility for to immediately write.off investeringer investments

(458) Da: Folket var begyndt <u>at virkelig lide</u>
 People-the was begun to really suffer
 under hendes moders indisposition
 under her mother's indisposition

(459) Da: Er det ikke sådan lidt politisk ukorrekt <u>at</u> **ligefrem** Is it not sort.of a.bit politically incorrect to downright

> <u>nyde</u> synet af krig og vold og alt sådan noget? enjoy sight-the of war and violence and all such stuff

The fact that there are significantly fewer examples of the *at*-adverb order (compare the tables in (451) and (455) above) strongly suggests that the adverb-*at* order is the unmarked one.

Of the seven examples of *at–ikke–*(adverb)–verb_{Inf} one is most likely a typo (otherwise it would have a very odd interpretation):

(460) Da: ??Når vi laver aftaler med briterne eller franskmændene When we make deals with British-the or French-the behøver vi at ikke skrive ned, hvor mange enheder vi har need we to not write down how many units we have

So, there are only six clear examples in 40 million words, two of which ((465) and (466)) are clearly stylistically marked (indicated with #); note also that example (462) has both orders:

(461) Da: Har han tendenser til <u>at</u> **ikke** <u>respektere</u> dine grænser Has he tendencies to to not respect your limits

og være lidt voldelig?

(462) Da: En anden vigtig ting som jeg personligt tror vi ofte An other important thing that I personally think we often

> glemmer er <u>at</u> **ikke** <u>overse</u> forpligtelser overfor andre f.eks. forget is to not overlook obligations towards others e.g.

ikke at svigte familien, til fordel for kirken.
not to let.down family-the in favour of church-the

(463) Da: Ikke sværhedsgraden, men <u>at</u> ikke <u>afsløre</u> sig selv, Not level.of.difficulty-the but to not reveal SELF self

> og sin syge tankegang and ones sick mind

(464) Da: Sarkasme består i <u>at</u> **ikke** <u>se</u> sine egne fejl Sarcasm consists in to not see ones own errors

og sige dem om andre and say them about others

(465) Da: #Jeg så solen sort og skrev det for <u>at</u> ikke $d \sigma$ I saw sun-the black and wrote it for to not die

men bare lige trække vejret
but just even draw breath

(466) Da: #Da moderen hentede hende, lovede hun When mother-the collected her promised she

> <u>at</u> **ikke** <u>fortælle</u> det til faderen to not tell it to father-the

What makes (465) stylistically marked is the poetic phrase, *solen sort* 'the sun black'. The clause could be paraphrased as *jeg så at solen var sort* 'I saw that the sun was black' or simpy *solen var sort* 'the sun was black'. In (466) the giveaway is the archaic/literary *moderen* and *faderen* which in is normally written *moren* and *faren* corresponding (more or less) to their

modern pronunciation. I find all examples in (461)-(466) marked and I strongly prefer to have negation before *at*.

Taking the corpus search results to support my judgments in (448), the pattern for Danish is summed up in the tree structure in (467) below:



NEG-shift data also show that *at* does not move higher than T°, as it can not precede the negative object in spec-NegP (a search in Korpus90/2000 gave zero examples of the order in (468)b):

(468) Da: a. [Ingen venner <u>at have</u>] er trist b. *[<u>At</u> ingen venner <u>have</u>] er trist

There is also the logical possibility that the infinitive marker moves string-vacuously to Neg^o where it also follows the negation marker in spec-NegP. I assume that movement to Neg^o only takes place when the verb is attracted to Fin^o or C^o in order to satisfy the Head Movement Constraint (HMC). However, the absolute status of the HMC is questioned in recent linguistic theory (cf. Chomsky 1995: 307; see also Julien 2000: 100) and head movement may indeed skip Neg^o as there is no empirical evidence to show that it is ever overtly filled in the languages in question (the clitic negation markers in Icelandic,

Norwegian, English, and Swedish show that Neg^o may be overt but, being affixal, it is always moved with the verb to Fin^o or higher).

According to Falk & Torp (1900: 300), in Early Modern Danish (EMD) the infinitive marker often precedes negation and other adverbials. In other words, Early Modern Danish has optional movement to Fin^o (their examples only illustrate VP-adverbials):

 (469) EMD: <u>at</u> iljde <u>brwge</u> rigdom to badly use riches (1526, Poul Eliesen, Falk & Torp 1900: 300)
 (470) EMD: <u>at</u> lettelige <u>foracte</u> to easily despise (1575, Anders Sørensen Vedel, Falk & Torp 1900: 300)

Interestingly, both the infinitive marker and the verb may precede adverbials, an option also found in Modern Icelandic:

(471) EMD: sinntes <u>at haffue</u> aldelis forført seems to have completely seduced (1575, Anders Sørensen Vedel, Falk & Torp 1900: 299)

(472) EMD: sagde sig nu <u>at skulle</u> icke lade hannem vere der lenger said SELF now to should not let him be there longer (1574-1597, Bishop Jens Nielsen, Visitatsbog, Falk & Torp 1900: 299)

In section 3.3.3.6 below, I present an analysis of this second option.

3.3.3.2 English

English *to* may optionally move to T^o to precede VP-adverbials, as the examples in (473) and (474) show (see also examples (442) and (443) above). Examples (475) and (476) shows that it may also optionally move to Fin^o to precede negation (see also Greenbaum & Quirk 1990:162, Radford 1997: 29):

(473) En: If we are ever **fully** to <u>understand</u> consciousness... (http://www.theage.com.au/articles/2003/03/31/1048962697709.html) (474) En: I want you to **fully** understand the gravity of the situation.

(Radford 1997: 29)

(475) En: I want you **not** to see anyone. (Bolinger 1977: 38)



3.3.3.3 Faroese

In Faroese, the infinitival marker never moves to Fin^o as it cannot precede negation or sentential adverbials:

(478) Fa: a. Hon hevur lovað ikki <u>at</u> gera tað aftur b. *Hon hevur lovað <u>at</u> ikki gera tað aftur She has promised to not do that again (Zakaris Hansen, p.c.) The same is the case with NEG-shift. The infinitive marker never moves to Fin^o and therefore never precedes the negative object:

(479) Fa: a. Eg havi roynt ongar feilir <u>at</u> gera
 b. *Eg havi roynt <u>at</u> ongar feilir gera
 I have tried to no mistakes make

I have not been able to establish whether VP-adverbials are allowed to intervene between *at* and the infinitive verb in Faroese (neither Lockwood 2002 nor Thráinsson et al. 2004 discuss it). I shall assume it not to be the case and leave the question for future research.



3.3.3.4 Norwegian

Like English, Norwegian also allows sentential adverbials, as in (481), and negation, cf. (482), to intervene between the infinitive marker and the verb. Note that in (483) the adverb that splits the infinitive is the VP-adverbial *berre* 'just': 66

(481) No: Så må du passa på <u>å</u> alltid <u>avbestilla</u> bøkene Then must you mind on to always cancel books.the "Then you must remember to always cancel the books." (Bergens Tidende)

⁶⁶ All Norwegian examples are from the Nynorsk part of the Oslo Corpus of Tagged Norwegian Texts, University of Oslo, <u>http://www.hf.uio.no/tekstlab/</u>.

(482) No: Det var meininga <u>å</u> ikkje <u>lyse</u> ut nokon ny anbods-It was intention.the to not announce PRT any new tenderkonkurranse competition (Bergens Tidende)

(483) No: Annleis vil det vere om dei har halde på med <u>å</u> berre <u>slå</u> Different will it be of they have held on with to just hit "It would have been different if they had just kept hitting." (Lokalaviser)

The infinitive marker can either precede or follow negation and/or VP-adverbials, which shows that there is optional v_{INF}° -to-Fin^o movement as well as optional v_{INF}° -to-T^o movement:

(484)No: Bjørn Eidsvåg hadde bestemt seg for **ikkje** å gje konsertar Bjørn Eidsvåg had decided SELF for not to give concerts i sommar in summer "B.E. had decided not to give concerts in the summer." (Bergens Tidende) (485) No: Eq vil råde dei unge til **ikkje** å bli gamle. I will advice the young to not to become old (Bergens Tidende) (486) No: Dette er eit betre utgangspunkt enn **berre** å seia at ... This is a better starting-point than just to say that (Bergens Tidende)

The Norwegian optional movement is illustrated in (487) below. Note that the pattern is the same as the English one in (477) above.


As Norwegian allows negation to intervene between the infinitive marker and the verb, as Swedish does, one might expect that NEG-shift should also be able to split the infinitive. This is not borne out. NEG-shift is not possible in infinitival clauses:

(488)	No:	a.	* [ingen	venner	å	ha]	er	trist	
		b.	*[<u>å</u>	ingen	venner]	ha]	er	trist	
			to	no	friends		have	is	sad	
			"To	o have r	no friends i	is s	ad"			(Janne Bondi Johannessen, p.c.)

In fact, Norwegian *ingen* is much more restricted than in the other Scandinavian languages. In colloquial Norwegian, NEG-shift is subject to Holmberg's generalization and cannot cross the verb (cf. chapter 0, section 2.4.3.2). As the infinitive verb cannot move across the infinitive marker and clear the way for string-vacuous movement, NEG-shift is blocked.

3.3.3.5 Swedish

In Swedish, the infinitive marker *att* obligatorily precedes negation (Holmes & Hinchliffe 2003: 476) and therefore it must move to Fin^o. That split infinitives are not limited to negative adverbials is shown in the example (491) (cf. Holmes & Hinchliffe 2003: 508). ⁶⁷

(489)Sw: Vi uppmanade att **aldrig** göra om det dem We encouraged them to do again it never (Holmes & Hinchcliffe 2003: 476) (490)Sw: For att inte tala om alla dessa kvinnor For to not talk about all these women (Title of a 1964 screenplay by Ingmar Bergman) (491) Sw: Att **verkligen** kunna läsa innebär att man kan följa ett really be.able.to read entails that one can follow an TOintellektuellt resonemang (Göteborgs-Posten 97) intellectual reasoning (492)Sw: FinP Spec Fin' PRO₁ Fin^o NegP att Spec Neg inte Neg^o TP \mathbf{t}_{att} Spec T' t_1 Т° *v*_{INF}**P** t_{att} Adv *v*_{INF}**P** Spec VINF' t_1 *v*_{INF}° vP $[t_1 \text{ Verb } \dots]$ t_{att}

⁶⁷ Examples (491), (493), and (494) are taken from the Språkbanken corpus, University of Gothenburg, <u>http://spraakbanken.gu.se/</u>.

In Swedish, a negative object that has undergone NEG-shift may also split the infinitive:

(493) Sw: Den utbredda vanmakten, känslan av The widespread powerlessness, feeling.the of <u>att</u> inget begripa (Svenska Dagbladet) to nothing comprehend (494)Sw: att känna hur skönt det kan vara att **inget** ha To feel how wonderful it can be to nothing have (Svenska Dagbladet)

This follows from the obligatory movement of att to Inf^o above NegP, as illustrated in (492).

3.3.3.6 Icelandic

In Icelandic, there are two possible movements of the infinitive marker $a\delta$: alone or together with the verb (judgements due to Gunnar Hrafn Hrafnbjargarson, p.c.). As (495)d show, $a\delta$ may move to Fin^o where it precedes negation, contrary to what is claimed by Holmberg (2000: 456, footnote 12). (495)b shows that $a\delta$ can not move to T^o between sentential negation and the VP-adverbial and stay there, and (495)c shows that $a\delta$ for some reason con't cross two adverbials. As the difference between (495)c and d also shows, VP-adverbials are normally right-adjoined. The markedness of (495)a, is due to either (i) (i) double stylistic fronting (of *ekki* and *strax*) (see section 3.2.3.2 above), (ii) *strax* is not right-adjoined, or (iii) $a\delta$ in situ.

(495) Ic: a. ?Það væri vitlaust ekki strax <u>að lesa</u> þessa bók
b. *Það væri vitlaust ekki <u>að</u> strax <u>lesa</u> þessa bók
c. *Það væri vitlaust <u>að</u> ekki strax <u>lesa</u> þessa bók
d. Það væri vitlaust <u>að</u> ekki <u>lesa</u> þessa bók strax

The second (and unmarked) type of movement is the one in (496)a and b where the infinitive verb has moved to adjoin to $a\delta$ with subsequent movement to Fin^o of this complex head $[a\delta+[v+V]]$, illustrated in (497). Note that with $[a\delta+[v+V]]$ movement, *strax* can be either left or right-adjoined:

- (496) Ic: a. Það væri vitlaust <u>að lesa</u> ekki strax þessa bók
 b. Það væri vitlaust <u>að lesa</u> ekki þessa bók strax
- (497) Icelandic V^o-to- v_{INF}^{o} incorporation:



Thus, movement to Fin^o is obligatory: either by $a\delta$ alone (the same pattern as that for Swedish, see (492) above), or as the complex head $[a\delta+[v+V]]$:



There are two additional relevant examples: In (499)a, *bessa bók* has undergone OS and precedes negation which in turn precedes the VP-adverbial *strax*; in (499)b, *ekki* has undergone SF to FocP above FinP, cf. section 3.2.3.2:

(499) Ic: a. Það væri vitlaust <u>að lesa</u> þessa bók **ekki strax** (OS)
 b. Það væri vitlaust **ekki** <u>að lesa</u> þessa bók **strax** (SF+OS)
 It be stupid not to read this book immediately

In fact, (499)b is structurally ambiguous between as to whether the object has undergone OS or not; the difference is string-vacuous because both base- and target position follow $[a\delta + [v+V]]$ in Fin^o and precede the (most likely) right-adjoined *strax*:

```
(500) a. [FocP ekki [FinP PRO <u>að lesa</u> Obj [NegP t<sub>ekki</sub> ... [VP t<sub>v</sub> t<sub>Obj</sub> ] strax ]]]
b. [FocP ekki [FinP PRO <u>að lesa</u> [NegP t<sub>ekki</sub> ... [VP t<sub>v</sub> Obj ] strax ]]]
```

When the object is negative it has to move to spec-NegP to license sentential negation. Unlike Swedish, this operation is not allowed to split the infinitive. Instead, the $[a\delta+[v+V]]$ complex moves to Fin^o and the object undergoes NEG-shift:

```
(501) Ic: a. * [enga vini] <u>aõ eiga</u> (er ákaflega leiðinlegt)
    b. *<u>aõ</u> [enga vini] <u>eiga</u> (er ákaflega leiðinlegt)
    c. <u>aõ eiga</u> [enga vini] (er ákaflega leiðinlegt)
    to have no friends (is awfully boring)
```

That the negative object *enga vini* 'no friends' in (501)c is not to be interpreted as an instance of zero-quantification (cf. chapter 0, section 2.3.5) is clear in examples with auxiliary verbs. The infinitival $[a\partial + [v+V]]$ complex has moved to Fin^o and the object has undergone NEG-shift as it precedes the main verb participle:

(502) Ic: [<u>að hafa</u> [enga vini] átt] hefur verið ákaflega leiðinlegt to have no friends had has been awfully boring
(503) Ic: [<u>að hafa</u> [engar bækur] lesið] var ákaflega vitlaust to have no books read was awfully stupid

What the examples above show is: (i) that Icelandic allows split infinitives, (ii) that V°to-Fin° movement is not restricted to finite verbs, but (iii) that the infinitive marker incorporates the infinitive verb and carries it to Fin^o as a complex head. However, the movement of the infinitive verb is only licensed in the company of the infinitive marker $a\delta$ (regardless of subsequent OBJ-shift as in (504)c), as the following ECM examples show (the (a) examples are actually potentially ambiguous, at least structurally, between embedded and matrix negation; I return to this shortly):

(504)Ic: a. Hann sá [mig ekki lesa bókina] b. *Hann sá [mig ekki bókina] lesa c. *Hann sá [mig lesa bókina ekki] saw me.ACC read book.the not He "He saw me not reading the book." (505)Ic: Og minn betri helmingur kvað ... better half And my said **ekki** hafa látið svo ófriðlega a. [miq í svefni] b. *[mig hafa **ekki** látið svo ófriðlega í svefni] me.ACC have not acted so unpeacefully in sleep "And my better half said that I hadn't slept so unpeacefully."

(a: http://www.armenn.is/Pdf/TBLMAI00.pdf)

In embedded finite clauses such as embedded questions, the non-finite verb cannot move to Fin^o. $A\delta$ is blocked in such contexts (the [+Fin] probe merged above TP and NegP will not be able to find a matching goal). Finite auxiliary verbs move to Fin^o above negation while the non-finite participial main verb remains below negation – there is no possible landing site higher in the structure and no $a\delta$ to act as a carrier.

Johnson & Vikner (1998), arguing for generalized V2 and CP recursion in Icelandic also note that ECM constructions have some peculiar properties. Following Sigurðsson (1989), they claim that ECM constructions can not have a NegP:

(506) For some unknown reason, non-control infinitives in Icelandic are so anemic, that they do not allow for the kinds of adverbs usually used to determine whether verbs have moved or not. (Johnson & Vikner 1998: 15-16)

However, the data presented above are counterexamples to such a claim. The problem appears to be connected to the presence of an auxiliary verb in the **matrix** clause, **not** the negation in the embedded clause, compare (507) and (508):

(507) Ic: Pétur hafði talið Peter had believed

a. *[Maríu ekki hafa vaskað upp diskana]
b. *[Maríu hafa ekki vaskað upp diskana]
c. [Maríu hafa vaskað upp diskana] *Mary* (not) have washed up dishes.the
"Peter had believed that Mary had (not) washed the dishes."

(Johnson & Vikner 1998: 14, (41))

(508) Ic: a. Pétur taldi [Maríu ekki hafa vaskað upp diskana] b. *Pétur taldi [Maríu hafa ekki vaskað upp diskana] Peter believed Mary have not washed up dishes.the "Peter believed that Mary had not washed the dishes."

(Gunnar Hrafn Hrafnbjargarson, p.c.)

Without an auxiliary in the matrix clause, the finite main verb moves to C^o and it is not possible to tell from the surface string alone whether negation belongs to the matrix or the embedded clause. In fact, exactly as in Danish, such examples are ambiguous between the two readings which supports that negation can be in the embedded clause.

(509) Da: a. Jeg lovede ikke [at komme for sent]

I promised not to come too late
Matrix scope: "I didn't promise to be late."

b. Jeg lovede [ikke at komme for sent]

I promised not to come too late
Embedded scope: "I promised that I wouldn't be late"

The presence of an auxiliary in the matrix clause, as in (507), removes the ambiguity in that negation that follows the participle of the matrix clause must be in the embedded clause which is exactly what is **not** possible in Icelandic ECM constructions.

In ECM constructions without an auxiliary verb, such as (504)-(505) and (508), the ECM subject and the negation may both occupy two different positions, either in the embedded clause or in the matrix clause. As Sten Vikner (p.c.) has pointed out to me, whenever the verb (rather than T^o or some other functional head) checks case on the relevant

DP, object shift is licensed. With pronouns it is obligatory. Thus in (504)a, repeated here as (510)a and b, negation can be in either the matrix or the embedded clause while the ECM subject has undergone obligatory object shift:

(510) Ic: a. Hann sáv migi ekki tv [cp ti lesa bókina]
b. Hann sáv migi tv [cp ti ekki lesa bókina]
han saw me not read book.the
a. "He didn't see me read the book"
b. "He saw me not reading the book"

When the subject is a not pronominal, object shift is normally optional and both the position of the ECM subject and the position of negation are potentially ambiguous:

```
(511) Ic: Pétur taldiv
Peter believed
a. Maríu1 ekki tv [cp t1 hafa vaskað upp diskana]
b. Maríu1 tv [cp t1 ekki hafa vaskað upp diskana]
c. tv [cp Maríu ekki hafa vaskað upp diskana]
Mary not had washed up dishes.the
a. "Peter didn't believe that Mary had washed the dishes"
b. "Peter believed that Mary hadn't washed the dishes"
c. = b.
```

The analysis of Johnson & Vikner (1998) admittedly also wrongly predicts control infinitives to be extraction islands. They argue that $a\delta$ is base-generated in the higher C° in a recursive CP-domain and that PRO is topicalized to avoid government by the infinitive verb, which they argue is moved to the lower C°, cf. the example in (512). Thus, they have to make additional stipulations. The present analysis does not make such a prediction as $[a\delta+[v+V]]$ moves to C°, cf. the structure in (513):

(512) Ic: Hvernig₁ lofaði Pétur Jóni ... How promised Peter.NOM Jón.DAT

[CP að [CP PRO fara [IP til London á morgun t1]]]?
to go to London tomorrow

(Johnson & Vikner 1998: 31, (78b))

(513) Ic: Hvernig₁ lofaði Pétur Jóni … How promised Peter.NOM Jón.DAT

 $[_{CP} t_1 C^{\circ} [_{FinP} PRO [_{Fin^{\circ}} \underline{a\delta fara}] til London \acute{a} morgun t_1]]]?$ to go to London tomorrow

(Whatever the status of government in contemporary linguistic theory, the facts remain.)

The possibility of moving [at+[v+V]] in Early Modern Danish and $[a\partial+[v+V]]$ in Icelandic seems to correlate with / be licensed by V°-to-Fin° (V°-to-I°) movement. Among the modern Scandinavian languages, only Icelandic has V°-to-Fin° movement while Danish lost it sometime between 1300 and 1700. The movement of the infinitive marker alone is clearly not subject to such licensing condition.

3.3.4 Implications for Syntactic Structure

Danish *at* optionally moves to T° to precede VP-adverbials. Movement to Fin° is impossible as *at* obligatorily follows NegP. English *to* optionally moves to T° where it precedes VPadverbials and optionally to Fin° to precede NegP. Swedish *att* always moves to Fin° as it obligatorily precedes NegP, which may also be targeted by NEG-shift. Norwegian *å* optionally moves T° to precede VP-adverbials and optionally to Fin° where it precedes NegP. Icelandic $a\delta$ (and Early Modern Danish *at*) may optionally move to T° to precede VPadverbials and further to Fin° where it precedes NegP. The unmarked derivation, however, is the one where the verb is incorporated by $a\delta$ and this complex head moves to Fin°. This appears to be licensed by the 'V°-to-I° parameter'. This is summarized in (514) (recall that negation and sentential adverbials are merged between Fin° and T°, and 'VP-adverbials' are merged between T° and v_{INF} °):

	Fa: at	Da: at	EMD: at, En: to,	Ic: að,	EMD: <i>at</i> +Verb		
			No: å	Sw: att	Ic: að+Verb		
Fin [°]	×	×	✓	\checkmark	\checkmark		
T°	×	✓	\checkmark	×	×		
<i>v</i> _{INF} ^o	\checkmark	\checkmark	\checkmark	×	×		

(514) Variation in the position of the infinitive marker:

The base-position of the infinitive marker is the same cross-linguistically, namely in the functional projection $v_{INF}P$ at the top of the VP-domain. This is different from what is assumed elsewhere. The table below shows some examples of the various positions argued for the infinitive marker (*mutatis mutandis* as some of the authors use non-split IP or Infl). Interestingly, Beukema & den Dikken (1989) and van Gelderen (2004) also argue for optional movement (indicated with dotted arrows), but in the former case only for English and Norwegian.⁶⁸ It is also interestingly to note that Ernst (1992), following Pullum (1982), argues that English *to* is base-generated as a V^o.⁶⁹

Base-position	Chomsky (1981), Radford (1997)	Ernst (1992), Pullum (1982)	Haegeman & Guéron (1999)	Johnson & Vikner (1998)	Platzack (1986, 1998)	Beukema & den Dikken (1989)	Van Gelderen (2004)
C°				Ic: að	Ic: <i>að</i> Sw: <i>att</i>	Ic: að Sw: att	En: to
						No: å∢.	1
Fin ^o	En: <i>to</i>		En: <i>to</i>	Sw: att		En: <i>to</i>	, ,
Τ°				Da: at	Da: at	Da: <i>at</i>	1
			En: to		En: to	En: to	En: <i>to</i>
				No: å	No: å	No: ă	
V°		En: <i>to</i>					

(515) Suggested base-positions of the infinitive marker:

⁶⁸ Van Gelderen (2004: 247) argues that in Modern English, *to* can be in one of two positions. It is merged/basegenerated in Mood^o (assuming TP–NegP–MoodP–AspP to be the maximal sequence of projections in the IPdomain) and "that *to* moves from M [i.e. Mood^o, K.R.C.] to C on occasion." The former is an instance of "the lower *to*" (p.238), the latter "the higher *to*" C^o (241). "In present-day English, both M and C are used but in earlier forms *to* is 'lower' (probably in ASP), as are the modals. It is expected that further changes will continue the development and have *to* become a C element" (p. 248).

⁶⁹ See Abraham (2004) who argues that German zu and Dutch te are prefixes base-generated as spec-vP absorbing the external θ -role of the verb.

Bobaljik & Thráinsson (1998) argue that only Icelandic has a split IP while the other Scandinavian languages and English have a simple un-split IP (that is, in the present analysis, no TP between NegP and vP). The data presented here show that this cannot be correct (or at the very least, it does not have to be). All the languages must have more than one functional head in the IP-domain that can be targeted by movement of the infinitive marker: one preceding NegP, i.e. Fin^o, and one following NegP but preceding VP-adverbials, i.e. T^o.⁷⁰ (Further support comes from floating quantifiers which shows that several spec-positions are needed.) Even though the data presented here do not show it directly, this presumably also holds for Swedish. Sigurðsson (2003), elaborating on Chomsky's (2001) *Uniformity Principle* and the problematic language specific feature selection, argues that human language is subject to a universal principle which he calls the *Silence Principle* which states that all features, and therefore all projections, are universal.

(516) **The Silence Principle**

Languages have meaningful silent features; any meaningful feature may be silent (Sigurðsson 2003: 330, (7)).⁷¹

(517) **The Uniformity Principle**

In the absence pf compelling evidence to the contrary, assume languages to be uniform, with variety restricted to easily detectable properties of utterances (Chomsky 2001: 2, (1)).

Hence, there may always be silent (covert) projections in the structure even though there may be no direct empirical syntactic evidence to support them in every language.⁷² Furthermore,

⁷⁰ Alternatively, the IP-domain is the projections between NegP and vP (and may still be split into more projections, say, TenseP, MoodP, and AspectP). The projection immediately above, FinP, is then the lowest projection in the CP-domain and is the one formerly known as AgrSP. The important thing is that there is a projection between C° (occupied by the finite verb in main clauses in V2 languages), and negation in NegP (see chapter 0, section 2.3.3, footnote 15).

⁷¹ One obvious exception is negation, which cannot be completely silent/covert. No human language lacks an overt negation marker.

 $^{^{72}}$ There may, of course, be semantic, pragmatic, phonetic or prosodic (e.g. in *yes/no* questions without inversion, interrogative force is signalled with intonation) evidence that indicates the presence of certain functional features (for example [+Q]). This, however, presupposes that the computational system C_{HL} generates a single representation at the C-I interface incorporating all relevant information (which is more or less explicitly assumed as the standard in generative linguistics), rather than, say, a logico-semantic representation and a pragmatic representation, one of which includes scope relations, as well as an argument structure, etc. (as in Lexical Functional Grammar, LFG). As far as I see it, the latter merely pushes the problem of integrating all the

Chomsky (2001: 43, footnote 8) states that CP and TP may be cover terms for richer arrays of projections. In short, the point is that the clausal spine is, or at least can be, universal and fixed. (Elly van Gelderen 2004 argues somewhat in the opposite direction. According to her *Layer Parameter* (p. 4, (1)), languages may vary synchronically and diachronically with regard to which of the CP-, IP-, and VP-domains are "expanded" (articulated).

The distribution of the infinitive marker and negation and sentential and VP-adverbs shows that NegP can have the same structural position in all the languages, i.e. between FinP and TP. Ouhalla (1990: 199) argues that in English (and implies the same for Swedish, page 210), Neg^o selects VP, while French Neg^o selects TP. The present analysis shows that all of these languages (again except perhaps Swedish) may have the same "NEG-parameter" setting: Neg^o selects TP.

Contrary to what is argued by Johnson & Vikner (1998), Icelandic infinitive verbs do not move on their own as V°s (they argue that the verb moves through Fin^o to C°). The infinitive marker $a\delta$ attracts and incorporates the infinitive verbs prior to movement to Fin^o. For this reason the verb is able to escape the *v*P phase in Icelandic as opposed to the other languages in question. This complex head $[a\delta+[v+V]]$, **not** the infinitive verb, is able to check φ -features. I return to this shortly.

In Icelandic ECM constructions (non-control infinitives), there is no infinitival $a\delta$ and therefore no movement to Fin^o as the infinitival verb itself cannot check the features on Fin^o. I have presented data that show, contrary to what is claimed by Johnson & Vikner (1998) and others, that ECM constructions may have a NegP which makes it possible to positively identify the structural position of the verb.

The analysis presented here correctly predicts that control infinitives are not extraction islands, cf. (513), which the analysis in Johnson & Vikner (1998) predicts them to be.

3.3.5 Feature Checking and Infinitives

3.3.5.1 Control infinitives, ECM, and Raising

In control infinitives, PRO in spec-FinP checks EPP on Fin^o. I suggest that the infinitive marker can check φ -features on Fin^o. This is clear with Swedish *att* and Icelandic incorporating $a\delta$ which obligatorily move to Fin^o, as shown above. This also explains why the infinitive marker is obligatory in control infinitives:

information and representations into a coherent interpretation into the C-I interface. The problem hasn't been solved, it has been moved.

(518) Features checked by PRO and the infinitive marker (version 1):



According to Chomsky (2001: 6), "structural case is not a feature of the probes (T, v), but is assigned a value under agreement then removed by Spell-Out from the narrow syntax." In line with this, I assume that if and only if Fin^o assigns/licenses/valuates (nominative) Case, Fin^o has φ -features:

(520) Iff Fin^o valuates Case, Fin^o has φ -features

That means that Fin^o has no φ -features in ECM constructions (and Icelandic DAT-ACC clauses which I ignore here, but see Hrafnbjargarson 2004).

In ECM constructions, the subject DP moves to check EPP on Fin^o. There are no (strong unvalued) φ -features on Fin^o, and Icelandic $a\delta$ like Swedish *att* are not attracted to Fin^o and therefore, by economy, cannot move to Fin^o, cf. (521)a and b. The question remains why the infinitive marker is never allowed in ECM, not even in its base-position, as in (521)c. The answer I propose is that ECM verbs select [-Inf] clauses, a point to which I return in section 3.3.5.3 below.

(521)hafa vaskað upp diskana] (ECM) Ic: a. *Pétur taldi [að Maríu ekki b. *Pétur taldi [Maríu <u>að</u> **ekki** hafa vaskað upp diskana] c. *Pétur taldi Maríu **ekki** að hafa vaskað upp diskana] [Pétur taldi Γ ekki hafa vaskað upp diskana] d. Maríu Peter believed Mary not (to) have washed up dishes.the

In raising constructions, the raising subject DP checks φ and EPP on both the embedded Fin^o and the matrix Fin^o. Again, *að/att* would not be able to check φ and is therefore not licensed.

(522)	Ic:	a.	*Hann	virtist	[<u>að</u>		ekki	tala	fullkomna	íslensku]	(Raising)
		b.	Hann	virtist	[ekki	tala	fullkomna	íslensku]	
		с.	*Hann	virtist	[<u>að</u>	tala	ekki		fullkomna	íslensku]	
			Не	seemed	to	speak	not		perfect	Icelandic	

Danish *at*, English *to*, and Norwegian *å* are obligatory in both ECM and Raising constructions:

(523) (ECM) Da: a. Jeg anser [ham for ikke at være kompetent] b. *Jeq anser [ham for ikke være kompetent] Ι consider him for not to be competent (524) (Raising) Da: a. Hun synes [at tale flydende dansk] b. *Hun synes [tale flydende dansk] She seems to speak fluent Danish

An exception to the rule is ECM under perception verbs which does not license the infinitive marker in the Germanic languages (in section 3.3.5.3 I argue that this is because perception verbs select complements with a [-Inf] feature).

(525) a. Da: Jeg hørte [hende (*at) spille klaver] b. En: I heard [her (*to) play the piano] c. Ic: Ég heyrði [hana (*að) leika á píanó]

Alternatively, it could be argued that Danish and Norwegian do not have ECM outside the perception verbs. Arguably, then, examples such as (523) would have to be analyzed as double object constructions where the direct object is a CP obligatorily headed by the complementizer *for*; CPs are normally considered barriers for ECM. However, that is not unproblematic in my opinion, as the double object construction normally includes a recipient which is not compatible with (523).

Consider also the example in (526) which could be taken to suggest that *for*-clauses are not ECM complements (i) because of its surface similarity with the *for*-clauses in (527), and (ii) because its grammaticality status is different from the perception verb ECM in (528)a:

(526)	Da:		Jeg	ha	r	hende	ikke	anset		foi	: at	være	én	af	de	bedste
(527)	Da:	a. b.	Jeg Jeg I	ha an <i>co</i>	r ser nsider	<u>hende</u> her	ikke ikke not	anset	hende	for for	• at • at • <i>to</i>	være være be	én én <i>one</i>	af af of	de de <i>the</i>	bedste bedste best
(528)	Da:	a. b.	*Je Je I	∋g	har har <i>have</i>	<u>hende</u>	ikke ikke not	e hørt e hørt <i>hear</i>	<u>hen</u> d her	<u>de</u>	spi: spi: play	lle k lle k 7 p	lave lave pianc	er er		
		c.	J€ I	∋g	hørte <i>heard</i>	<u>hende</u> her	ikke not	2			spi] play	lle k v p	lave ianc	er D		

The ungrammaticality of (528)a as opposed to (528)c follows from the fact that OS cannot cross a verb. Once the object, for whatever reason, has entered the main clause, as in (528)c, it is subject to OS.

If (526) were a double object construction with *hende* as the indirect object, the matrix main verb should block OS contrary to fact: *hende* clearly precedes matrix negation.

It is important to note that (526) and (527)a are **not** synonymous: (526) is interpreted as being in the simple present tense, whereas (527)a is in the present perfect. They mean more or less the same as (529)b and a respectively:

(529) a. I don't consider [her to be one of the best] = (526), (527)bb. I didn't consider [her to be one of the best] = (527)a

The fact that (526) is interpreted as having simple present tense suggests that *har* is the main (matrix) verb taking as its complement a small clause. *Hende* undergoes OS into the matrix clause while the remnant of the infinitival (ECM) clause is right dislocated (undergoes "heavy-XP shift") and right-adjoined to the small clause (SC):

(530) Da: Jeg har $\underline{hende_1}$ ikke $[[_{sc} t_2 \text{ anset}]$ $[t_1 \text{ for at være én af de bedste}]_2]$ *I* have her not considered for to be one of the best

Instead I propose that *for*-clauses are indeed ECM construction and that *for* occupies Fin^o, rather than C^o, and that the embedded subject *hende* is in spec-FinP where is available for case marking from the matrix verb. *For* heads infinitival clauses and may therefore be taken to be the overt carrier of the [-Fin] feature on Fin^o (unlike the complementizer *for*

synonymous with *fordi* 'because'). Furthermore, in Swedish, *att* and *for* seem to compete for the same head position as they are in complementary distribution.

The distribution of the infinitive marker is summarized in the table in (531) below (see also Beukema & den Dikken 1989: 66-67):

Infinitive marker	Control infinitives	ECM	Raising
Danish at	\checkmark	\checkmark	\checkmark
English to	\checkmark	\checkmark	\checkmark
Norwegian <i>å</i>	\checkmark	\checkmark	\checkmark
Icelandic <i>að / að</i> +Verb	\checkmark	×	×
Swedish att	\checkmark	×	×
Faroese at	\checkmark	×	×

(531) Distribution of the infinitive marker:

But why, then, are Danish *at*, English *to*, and Norwegian *a* obligatory in ECM and Raising (leaving Faroese aside for the moment)? If it is assumed that there is a difference in the properties of PRO and the infinitive marker (i.e. the difference is lexical), the observed variation in (514) above follows: In Icelandic and Swedish, the infinitive marker checks the φ -features (obligatory v_{INF}° -to-Fin^o movement), while in Danish, English, and Norwegian this is done by PRO (optional v_{INF}° -to-Fin^o). (I leave to future research to answer the question why Icelandic and Swedish PRO can not check φ -features. However, assuming Icelandic to reflect earlier diachronic stages, a possible answer may be that PRO in the other Scandinavian languages is (or has been) getting stronger (by reanalysis) and is taking over checking of φ -features from the infinitive marker, reducing the number of moving elements by one.)

(532) Features checked by PRO and the infinitive marker (version 2):

	PRO	Infinitive marker
Ic að+Verb, Sw att	EPP	Inf, φ
Da at, En to, No å	EPP, φ	Inf

As mentioned in section 3.3.3.6 above, the movement of the Icelandic $a\delta$ without the infinitival verb is marked (movement of $[a\delta+[v+V]]$ is preferred). The feature distribution in (532) provides us with a possible explanation for this markedness. Not moving $a\delta$ is marked because the φ -features on Fin^o remain unchecked. Moving $a\delta$ alone to check the φ -features on Fin^o is marked because the infinitival verb is 'stranded', or rather $a\delta$ has failed to incorporate it.

I propose that the optionality of the movement of Danish at, English to, and Norwegian a has to do with scope relations, (e.g. whether the infinitive scopes over e.g. negation or vice

versa), which is applied to varying degrees in the languages, and/or information structure (focus and presupposition), **not** feature checking.

b. [_{FinP} PRO to [_{NegP} not [_{TP} win the Olympics is okay]]].
 Meaning ≈ "Losing is not okay."
 Presupposition: The Olympics actually takes place.

The adverbials cannot move (assuming that XP movement is driven by EPP, movement to adjunction is out), but the infinitive marker, being a head, can. In this way, the scope-taking elements are XPs (demanding that certain other elements, including heads, be in their domain) rather than heads (cf. also Chomsky 2001: 37 who argues that head movement falls within the phonological component).

Swedish *att* has lost its ability to incorporate while Icelandic $a\delta$ and Early Modern Danish *at* has retained this ability. This indicates that it might be licensed by V°-to-Fin° movement, cf. section 3.3.3.6 above (the exact connection or licensing condition between the two remains to be explained). I propose that incorporation is motivated by an uninterpretable feature [+Incorp] on the infinitive marker (there are thus two versions of $a\delta$, one [+Incorp] and one [–Incorp]).

	PRO	Infinitive marker
Ic að	EPP	Inf, +Incorp, φ
Sw att	EPP	Inf, –Incorp, φ
Da at, En to, No å	EPP, φ	Inf, –Incorp

(534) Features (on or) checked by PRO and the infinitive marker (version 3):

If Faroese *at* does not leave v_{INF}^{o} , it is an interesting 'intermediate' candidate. As shown in (531), it patterns with its Swedish and Icelandic counterparts, as *at* is not licensed in ECM and Raising constructions but obligatory in control infinitives (examples from Lockwood 2002: 138-139; see also Petersen et al. 1998 (and 2004), section 5.8.2):

- (535) Fa: a. Hon ynskti sær [at verða jarðað í Borðoy] b. *Hon ynskti sær [verða jarðað í Borðoy] She wished SELF to be buried in Borðoy "She wished to be buried in Borðoy."
- (536) Fa: a. *Nú haldi eg [meg <u>at</u> hava prátað nóg nógv] (ECM) b. Nú haldi eg [meg hava prátað nóg nógv] Now think I me to have talked quite enough "Now I think I've talked quite enough."
- (537) Fa: a. *Mær tókti [at hóma býir við føgrum marmorborgum] (Raising) b. Mær tókti [hóma býir við føgrum marmorborgum] I seemed to remember cities with beautiful marble-palaces

The infinitive marker stays inside v_{INF}^{o} because it can not check φ on Fin^o (and possibly because scope does not influence the surface string). The question is why it is blocked in ECM and Raising. I propose that Faroese is like Icelandic and Swedish, such that *at* checks φ in control infinitives 'covertly' and PRO checks EPP, and it is blocked in ECM and Raising because Fin^o has no φ -features. Fin^o probes for a φ match and *at* in v_{INF}^{o} is available because it is already at the phase edge. In other words, instead of Fin^o attracting *at* as in Icelandic and Swedish, Fin^o and *at* enter into **long-distance agreement**. If correct, there is thus a difference in strength of the φ -features on Fin^o:

	PRO	Infinitive marker	Fin [°] [φ]
Ic að	EPP	Inf, +Incorp, φ	Strong
Sw att	EPP	Inf, –Incorp, φ	Strong
Fa at	EPP	Inf, –Incorp, φ	Weak
Da at, En to, No å	EPP, φ	Inf, –Incorp	Strong

(538) Features (on or) checked by PRO and the infinitive marker (final version):

In French and Latin, the infinitival marker is realized morphologically. Here, v_{INF}° is a strong affix inducing verb movement. In Biblical Hebrew, the infinitive is expressed morphologically with vowel change (or, rather, an infix: Consonant-Consonant-*o*-Consonant on regular "strong" verbs). (In the table, the term 'present' is a bit misleading, because Biblical Hebrew does not have tense inflection but inflects for perfect/imperfect aspect.)

	English	French	Biblical Hebrew
Infinitive	to love	aim-er	'ehov
		love-INF	love.INF
Present	(we) love	aim-ons	ni-'hov
		love-3 rd .PL.PRES	3 rd .PL.IMPERF-love
Infinitive	to write	écri-re	kotov
		write-INF	write.INF
Present	(we) write	écri-vons	ni-ktov
		<i>write</i> -3 rd .PL.PRES	3 rd .PL.IMPERF- <i>write</i>

(539) Infinitival morphology:

In Polish, the infinitive is also marked with an affix (one of fifteen possible forms, depending on the verb class, cf. Bielec 1998: 17). In French, Latin, Polish, and Biblical Hebrew, v_{INF}^{o} is affixal, not an incorporating word like the English *to*.

3.3.5.2 Other 'Strange' Cases

 Φ -features are normally checked on heads by DPs or by a finite verb, but in the present analysis it is done by a non-finite verbal head, namely, the infinitival marker, in Icelandic and Swedish. Alexiadou & Anagnostopoulou (1998) argue for another 'unusual' checking by a verbal head. They argue that in VSO constructions in e.g. Greek and Spanish (which, unlike e.g. English and the Scandinavian languages, lack an expletive pronoun like *it/there*), the verb moves to Fin^o and checks the EPP (and therefore, there is no expletive pro in spec-FinP (they use AgrSP)). This is possible because "the verbal agreement morphology has the categorial status of a pronominal element" (Alexiadou & Anagnostopoulou 1998: 494). Here, EPP is a nominal feature, not strictly a licensor of a specifier, which the authors argue is not projected.

According to Holmberg & Nikanne (2002: 5), "a characteristic property of Finnish is that I is visibly split into F [which is mnemonic for Finite] and T in one construction, namely negative finite sentences: The negation is inflected for subject agreement while the next head down, either the auxiliary or the main verb, is inflected for Tense and Mood." The following table shows the inflectional paradigm for the Finnish negation:

	1	Number
Person	Singular	Plural
1^{st}	en	emme
2^{nd}	et	ette
3 rd	ei	eivät

(540)	Finnish	negation
()		

Finnish negation is thus another case where typical DP features are checked by a verbal element. In negative finite clauses the verb raises to T°, while the negation marker raises to Fin° where it agrees (partially) with the subject. According to Mitchell (in press: 2), "one characteristic shared by many of the Finno-Ugric languages is that negation is expressed with a negative auxiliary which shows agreement with the subject of the sentence." In other words, Neg° checks φ -features on Fin°, just like the infinitival marker v_{INF} ° in Icelandic and Swedish in the present analysis. While Finnish allows any order (with different interpretations) of subject, verb, and object, the subject must immediately precede negation, which shows that negation moves to Fin° where nothing can possibly intervene between the two (see Manninen 2003, section 2.3, Kaiser, in press):

- (541) Fi: a. Sinä syö-t etanoita You eat-PRES.2SG snails.PART "You eat snails." (Manninen 2003: 56, (13a)
 - b. Sinä <u>e-t</u> ole syönyt etanoita
 You not-2.SG be.PRES eat.PTCP snail.PART
 "You have not eaten snail."
 (Manninen 2003: 56, (13c)
 - c. Opiskelijat <u>e-i-vät</u> kaikki ole muuttaneet uusiin Students not-3-PL all be.PRES move.PTCP new.ILLAT asuntoihin flats.ILLAT "The students haven't all moved to new flats." (Manninen 2003: 59, (19a)

(See also Mitchell, in press, who argues that NegP is below TP in Mordva, Mari, Komi, Udmurt, and Livonian, because the negative auxiliary carries tense as well as φ -features (i.e. Neg°-to-T°-to-Agr° movement), while NegP is above TP in Finnish, Karelian, Ingrian, Veps, Votian, Estonian, and Saami, because the negative auxiliary only has φ -features (V°-to-T° and Neg°-to-Agr°)).

3.3.5.3 A Typology of Verbs

In this section, I fit the [Inf] feature, and hence $v_{INF}P$, into a larger picture. First of all, I propose that the verbal or, rather, clausal features are ordered as in the hierarchical structure

in (542) below. The terminal nodes are numbered (a) to (g) and examples of each are given in (543).



The branching nodes in (542) are labeled with capitals, (A) to (F). Each such node refers to a class of clauses or verbs (heading clauses) with particular characteristics:

The class dominated by (A) [+Imp] contains only one member, the imperative. Clauses headed by a [+Imp] verb have smaller (or different) structure, cf. Jensen's (2003: 239) defective T_{IMP}° . Imperatives are thus neither finite nor non-finite.

The class of clause types dominated by (B) [-Imp], and only those, can be either interrogative [+wh / +Q] or declarative.

The class dominated by (C) [+Fin] are tensed. Furthermore, only [+Fin] verbs can be the only and/or topmost verb in a main clause, and only [+Fin] verbs undergo V2. (Not only those under (C) are tensed: Hebrew absolute infinitives occur in finite clauses; I return to this shortly.)

Only (D) [-Fin] clauses partake in ECM constructions. That is, the verb heading the embedded clause, is [-Fin], cf. (d3), (e3), and (g).

Only verbs under (E) [+Adj] can act as attributive adjectives, as in e.g. *the <u>approaching</u> train* and *the <u>recently</u> departed.*

Only verbs under (F) [-Adj] are 'infinitival'.

The terminal nodes (a)-(e) need no explanation, while the distinction between (f) and (g) does:

Only [+Inf] verbs, (f), can have the infinitive marker while verbs that are [-Inf], (g), 'lack' the infinitive marker. Clauses that are [-Inf] are for example infinitival complements of perception verbs such as *see*, *hear*, and *feel*. Perception verbs may, however, take complements from either (b), (c), (d), (e), or (g) – but not (f). If it is assumed that the infinitive verb in Faroese, Icelandic, and Swedish ECM construction is also [-Inf], it explains why the infinitive marker (inherently [+Inf]) is blocked.

[+Inf] verbs are also the type selected by so-called catenative (or "chaining") verbs defined as verbs taking infinitive complements with the infinitive marker, for example:

(544)a. He seems/intends/needs [*(to) be leaving soon] En. b. She was asked [*(to) to remover her car] c. They were believed [*(to) be able to fly] (545) Da. a. Den ser ud til [*(at) mangle noget] It look out to to miss something "It appears to be missing something." b. Han trænger til [*(at) sove] He needs to to sleep "He needs to sleep."

Biblical Hebrew has two distinct forms of the infinitive: the *infinitivus constructus* (Inf. Con., the form used in (539) above) and the *infinitivus absolutus* (Inf. Abs.) (Pedersen 1995: 218-219, 228). The Inf. Con. is used as a 'normal' infinitive, whereas the Inf. Abs. is used to add emphasis or intensity to a finite verb of the same root. The former is [+Inf], may take a nominal object and person inflection, and be the complement of a preposition, the latter is [-Inf] and occurs in finite clauses.

There are thus non-finite forms inflected for tense or occurring in finite clauses. (The Hebrew Inf. Abs. may also be used the add emphasis to an imperative, in which case it follows the main verb which in turn may be taken to suggest that it is an adjunct.)

As mentioned the infinitive absolute may take person inflection. The subject (or the object) of the infinitive may be added to the verb in the form of nominal (possessive) inflection (evidence for its status of verbal noun) or as verbal person endings. Thus, in Biblical Hebrew, the verb moves to adjoin to the affixal v_{INF}^{o} and from there to Fin^o to check φ -features. Normally, checking of φ -features is associated with finite forms (or DPs). Another language that allows this exceptional φ -feature checking is Portuguese.

In Portuguese, there are also two infinitive forms, the 'normal' infinitive and the personal infinitive. The former is inflected on the verb as an infinitive affix (*-ar*, *-er*, *-ir*, or *- or*), the latter also inflects for person (verb-INF- ϕ) (cf. Hutchinson & Lloyd 1996: 71, Raposo 1987):

Person	Impersonal infinitive	Personal infinitive	
1. Sg.	cant-ar	(eu)	cant-ar
2. Sg.	sing-INF	(tu)	cant-ar-es
3. Sg.		(ele, ela, você)	cant-ar
1. Pl.		(nós)	cant-ar-mos
2. Pl.		(vós)	cant-ar-des
3. Pl.		(eles, elas, voês)	cant-ar-em

(547) Portuguese infinitives:

Raposo (1987) relates the inflected infinitive to the settings of two distinct parameters. The first parameter is a morphological one, namely what he calls the *Infl Parameter*, which given a "+" value allows free choice of [+/-Tense] ([+Tense] = finite Infl, [-Tense] = infinitival Infl) in an Infl with agreement. European Portuguese "is then positively marked for the Infl parameter, a highly marked choice in UG, given the number of known languages where this choice is or has been attested" (Raposo 1987: 92). The second parameter is a syntactic parameter, the well-known null-subject parameter.

As in Biblical Hebrew, the Portuguese infinitival verb moves to v_{INF}° to pick up the infinitival affix and to Fin^o to check φ -features. Again, this φ -feature checking is otherwise normally associated with finite verbs, but apparently, universally that is not the only option.

Another, well-known, example of a language with two infinitives is German. According to Gunnar Bech's famous classification, non-finite verbs can be classified according to their inflection in one of two levels/degrees (German *Stufen*): 1) supine or 2) participle, where only the latter, which is adjectival, inflects for person, number, and number (φ), Case, and comparative/superlative degree. Within each 'Stufe', there are three sub-groups or statuses. For the supine they are 1) the infinitive, e.g. *lieben* 'love', 2) the *zu* infinitive, *zu lieben* 'to love', and 3) the participle, *geliebt* 'loved' (Bech 1955/57, Wöllstein-Leisten et al. 1997: 66). Typically, the status 1 infinitives, the bare infinitives, are modal verbs, whereas lexical verbs have type 2 infinitives.

In languages like French, Latin, and Polish that do not have an infinitival marker, there is no overt difference between [+Inf] and [-Inf]. On universal grounds (cf. the Uniformity Principle (517) and the Silence Principle (516), it could still be argued that there is a covert difference, namely, that the former projects a $v_{INF}P$ and the latter does not, rather that the two are conflated in a single [-Adj] category. In Biblical Hebrew and Portuguese, the two different versions of the infinitive may be taken to a different use of the [+/-Inf] distinction.

Not only [+Fin] verbs check φ -features. It can also be done by, e.g., the Icelandic and Swedish infinitive markers (though it has no overt inflectional reflex), Finnish negation, and Portuguese personal infinitives. The φ -features are checked on Fin^o regardless of [+/-Fin] value. This leads back to the (C) [+Fin] option in (542) above. A functional head with a [+Fin] feature selects [+Tense], i.e. [+/-Past]. (I assume a [-Tense] T^o has the value [0Past] 'zero Past', not [*u*Past] which is uninterpretable.) I take this to support the assumption that the head that selects TP is in fact Fin^o (though FinP 'normally' belongs to the split CP-domain,⁷³ cf. Rizzi 1997), as Holmberg & Nikanne (2002) and Manninen (2003) do for Finnish.⁷⁴ The point is that [+Fin] inherently has an uninterpretable tense feature [*u*Past] and therefore, there must be an available [+/-Past] goal in its domain.)

⁷³ See footnote 70.

⁷⁴ Grimshaw (2003) argues that NegP is invisible to selection as it may or may not be projected and it may therefore either intervene or not. "Why is NegP invisible to selection? That is, why are higher heads never sensitive to the presence or absence of Neg? The type-category theory of selection answers this. First of all, Neg must form an extended verb projection, so we know that its category is the same as that of other member of the verbal set, including TP. Thus, no predicate could c-select NegP versus TP, or TP versus NegP, since NegP and TP are not distinguishable by category. Hence NegP is in effect invisible to c-selection" (Grimshaw 2003: 62).

The (D) [-Fin] option, illustrates the mutual independence between 'infinitivity' and aspect, as argued in section 3.3.1. Both (E) [+Adj], which dominates [+/-Perf], and (F) [-Adj], which dominates the infinitive forms, are daughters of (D); neither requires the other.

3.3.6 Conclusions

The cross-linguistics as well as language-specific distribution of the infinitive marker shows (i) that a position is needed between VP-adverbials and v° , namely the lowest possible position the infinitive marker can occupy: its base-position v_{INF}° ; this leads to a more articulated VP-domain consisting of (at least) $v_{INF}P$, vP, and VP; (ii) two positions are needed in the IP-domain to account for split infinitives, one above NegP, Fin^o, and one below it, T^o, showing that an unarticulated IP-domain is insufficient. The variation can be accounted for by assuming movement from v° , either to T^o or to Fin^o, apart from the option of having the infinitive marker remain in situ. Obligatory movement to Fin^o in Icelandic and Swedish is motivated by φ -feature checking. Icelandic has an incorporating version of the infinitive marker that attracts the infinitive verb and carries it along to Fin^o.

Optionality or absence of movement in Danish, English, (Faroese?) and Norwegian is motivated by scope while the φ -features on Fin^o are checked by PRO which has taken over this role from the infinitive marker.

There are two realization of v_{INF}° , one [+Inf] and one [-Inf]. How these two are realized and used is subject to variation. In the Germanic languages, the former is the 'true' or 'normal' infinitive, e.g. English *to*, or Swedish *att*, and the other is the 'bare' infinitive without the infinitive marker. Other languages inflect the two in different ways, such as in the Portuguese impersonal ('normal', inflected for infinitive) and personal infinitive (inflected for infinitive and person) and in Biblical Hebrew where the infinitivus constructus is a 'normal' infinitive while the infinitivus absolutus is used in finite clauses. This also supports a division between finiteness and infinitivity, merged as Fin^o and v_{INF}° , respectively.

This chapter and the preceding one have been about what motivates syntactic movement, both syntax-internal triggers, as with the feature-driven movement of the infinitive marker, but also motivation from e.g. the interface between syntax and the conceptual-intentional systems where constraints on information structure triggers movements, such as topicalization, QR, and NEG-shift. In the next chapter, I shall discuss the implementation of syntax in the brain and argue that the targets of movement are very important as they reflect interfacing between C_{HL} and other cognitive systems.

Part 2:

Syntactic Movement & the Brain



Illustration:

Brains Manipulated MR image.

4 Neurolinguistics

4.1 Introduction

Throughout the preceding chapters, a recurring and crucial notion has been the interfacing between syntax and other cognitive systems. In this chapter, I shall argue that the interfaces also have cortical reflexes.

In the first part of this chapter I shall first outline the theoretical approach I adopt, the Biolinguistic approach. It has in fact been the one applied throughout the preceding chapters as well, but in this chapter I shall apply it to the study of language and the brain. I shall discuss some problems with and challenges for neurolinguistics before turning to the crucial questions of modularity and implementation, lateralization and localization.

Next, I return to the notion of structure-to-meaning mapping, which will be important for the outline of the working hypothesis about the implementation of syntactic computation. I then discuss the primary region of interest, Broca's area, and its important role in syntactic processing before introducing the distributed syntax network which includes the classical language areas as well as areas in the left hemisphere and cerebellum. Next, I outline the Domain Hypothesis about the interfacing between syntax and other cognitive systems and the activation in the syntax network.

4.2 The Biolinguistic Approach to Language

The approach I assume, the *biolinguistic approach* (Jenkins 2000), takes as its fundamental object of inquiry a *cognitive capacity* which is rooted in our species-specific *biological endowment* (i.e. genetically determined, innate⁷⁵). This cognitive capacity enables us to

⁷⁵ "Well, the issue of innateness of language is a curious one. There is a huge literature arguing against the innateness of language; there's nothing defending the thesis. So the debate is kind of funny in that it is one-sided. Lots of people reject the proposal that language is innate but nobody ever answers them. The reason why nobody answers is that the arguments make no sense. There's no way to answer them.

To say that 'language is not innate' is to say that there is no difference between my granddaughter, a rock and a rabbit. In other words, if you take a rock, a rabbit and my granddaughter and put them in a community where people are talking English, they'll all learn English. If people believe that, then they believe that language is not innate. If they believe that there is a difference between my granddaughter, a rabbit and a rock, then they believe that language is innate. So people who are proposing that there is something debatable about the assumption that language is innate are just confused. [...] To say 'language is innate' is to express the belief that some crucial and relevant internal nature differentiates my granddaughter from rocks, bees, cats and chimpanzees. We want to find out what this internal nature is. On current understanding, it is an expression of genes, which somehow yields a language faculty (and, for example, a well-placed bone of the inner ear – in this case for mice as well). How is unknown, but that is true for vastly simpler questions as well. The informal statement that language is innate means something like this. Similarly, we can say that arms are innate to humans and wings to birds'' (Chomsky 2000*b*: 50-51).

acquire the natural languages we are exposed to in early childhood and use them for communication, interaction, and expression of thought. In other words, this capacity is our *linguistic competence*, the *language faculty*. (For arguments for dissociating language and general intelligence/cognition, language and communication, distinguishing between language acquisition and general learning, and the mutual independence between language and the theory of mind, see Christensen 2001.)

The language faculty is what we might call a mental 'organ', a subcomponent or module of the mind (see section 4.4), but not only of the mind: It is "an internal property of persons, a subcomponent of (mostly) the brain that is dedicated to language" (Chomsky 2004: 104). This dedication, however, may only hold for the linguistic system as a whole; "its elements might be recruited from, or used for, other functions." (Chomsky 2004: 124, footnote 1). This is a very narrow definition of language which is also often in generative linguistic literature referred to as *I-language* (Internal language), the parts of language internal to the mind/brain of the speaker/hearer. However,

(548) this biologically and individually grounded usage still leaves much open to interpretation (and misunderstanding). For example, a neuroscientist might ask: What components of the human nervous system are recruited in the use of language in its broadest sense? Because any aspect of cognition appears to be, at least in principle, accessible to language, the broadest answer to this question is, probably, "most of it." Even aspects of emotion or cognition not readily verbalized may be influenced by linguistically based thought processes. Thus, this conception is too broad to be of much use. (Hauser et al. 2002: 1570)

The definition of language I adopt here includes syntax, (lexical) semantics, and phonology (the parts of the computational system; competence) and excludes pragmatics (performance) and the higher cognitive systems with which it may interact (the Conceptual-Intentional interface). Of course, the internalist biolinguistic approach is not the only viable perspective on language. Other approaches may privilege external factors such as social, historical, and cultural aspects of language, as in e.g. sociolinguistics, pragmatics, and discourse analysis. Biolinguistics does not question the legitimacy of such approaches; they are merely complementary (cf. Rizzi 2004: 324). Likewise:

(549) Internalist biolinguistic inquiry does not, of course, question the legitimacy of other approaches to language, any more than internalist inquiry into bee communication

invalidates the study of how the relevant internal organization of bees enter into their social structure. The investigations are mutually supportive. In the case of humans, though not other organisms, the issues are subject to controversy, often impassioned, and needless. (Chomsky 2001: 41; emphasis added.)

The focus in biolinguistics is on the biological endowment, the internal core property. This core property is the computational system of human language C_{HL} that drives syntax (see chapter 1, section 1.2). C_{HL} is very narrowly defined and its status is special because it seems that every constructive approach to human language and its use presupposes it – at least tacitly.

In the next section I shall argue that an elaborate theory with sufficiently fine-grained units such as the one offered by generative linguistics is indeed required in neurolinguistics.

4.3 Challenges for Neurolinguistics

Neurolinguistic articles and papers very frequently lack linguistic sophistication and elaboration as well as concrete linguistic examples (see Grodzinsky 2002, 2003 for discussion). The technical details of the specific scanner (magnetic field strength, coil specifications, etc.), scanning method, and data manipulation are always included, whereas the actual object of investigation, i.e. language, is only analyzed or described with very little detail, if at all. Most often, even if the linguistic input is included, the specific linguistic analysis is not given.

Along similar lines, Poeppel & Embick (2004) argue that there are two potential problems with the way neurolinguistics is often conducted: the *Granularity Problem* and the *Ontological Incommensurability Problem*.

The first problem has to do with the different levels of granularity in the analyses of language in linguistics and in clinical neuroscience:

(550) **Problem 1: The Granularity Mismatch Problem**

Linguistic and neuroscientific studies of language operate with objects of different granularity. (Poeppel & Embick 2004: 2)

"In particular, linguistic computation involves a number of fine-grained distinctions and explicit computational operations. Neuroscientific approaches to language operate in terms of broader conceptual distinctions." (Poeppel & Embick 2004: 2-3) For example, experiments

may seek to locate neural correlates of language under the assumption that language is located in the brain in an isolable area, a module in the flesh; however, as I shall argue below, there may be no direct mapping between what is a module at the level of cognition or the 'mind' and what is a module at the level of the brain. In addition, it would be a gross simplification of the language faculty to suppose that it has no internal structure in the sense of internal modularization (see section 4.4) – language is not monolithic; it consists of subcomponents, such as syntax, semantic, and phonology. The same holds for studies of neural correlate of syntax and semantics, both of which consist of subcomponents themselves (for syntax, see chapter 1, section 1.2.2). Furthermore, clinical studies are traditionally based on processes, i.e. comprehension or production – clear underestimations of the complexity of language.

The second problem has to do with the different units of computation in linguistics and in neurology:

(551) **Problem 2: The Ontological Incommensurability Problem**

The units of linguistic computation and the units of neurological computation are incommensurable. (Poeppel & Embick 2004: 4)

For example, on the linguistic side fundamental elements of representation include distinctive features, syllables, morphemes, phrases, and clauses, while on the neuroscientific side fundamental elements include dendrites, neurons, cell-assemblies, populations and cortical columns. There is no one-to-one correspondence between these tow sets or between the elements within them. Furthermore, the basic operations are also different. Linguistic operations include concatenation (Merge), linearization, structure generation (Merge and Move), and semantic composition (the meaning of a complex constituent is a function of the meanings of its constituents); neurological processes include long-term potentiation, receptive field, oscillation, and synchronization.

What is required is an explicit framework that takes seriously the linguistic fine-grained distinctions, one that that operates with an apparatus compatible with the question of how and what is computed in the brain. I am convinced that the Minimalist Program is exactly such a framework (see also Marantz, to appear). If the need for explicit theory is taken seriously, it may in turn tell us something interesting about how the mind and the brain work.

4.4 Modularity and Implementation

Modularity can be found at different levels. To begin with, a distinction should be made between modularity in the sense of Fodor (1983) and the sense of modularity standardly assumed in generative linguistics. Fodor was concerned with *input* systems, that is, low level autonomous systems such as vision and auditory perception. This is not the kind of modularity generative linguists have in mind when they talk about, for example, the 'language module' and the 'phonological, syntactic, and semantic components' (for arguments for external and internal modularity of language, see e.g. Christensen 2001). They are *cognitive* modules and so are the part of language I am concerned with here, namely, C_{HL}. This kind of modularity is not concerned with input systems; it "is concerned with cognitive systems, their initial states and states attained, and the ways these states enter into perception and action" (Chomsky 2000*a*: 20). That is, acquisition, competence, and interfacing. But there is nothing a priori excluding the possibility that some subcomponents may be Fodorian input systems, that is, informationally encapsulated and autonomous modules; possible candidates include the processes of Merge and Move, and possibly also the cyclic recursive syntactic derivation itself.

The fact that we may find distinct modules at the cognitive level, however, does not necessarily mean that we expect to find a corresponding single module at the level of the brain. We may find modular structures at each biological level of description, from the level of cognition (face recognition, theory of mind, language and subcomponents, etc.) to the level of cell structure in individual neurons (cf. Jenkins 2000: 65). However, there may not be any simple or direct mapping from one level to another. In other words, modularity at level n does not imply modularity at level n+1, or vice versa:

(552) Hence, although it is theoretically possible that there is a well-defined cortical (or other) region of the brain corresponding to the theoretical linguist's "syntactic component," it is just as possible in theory that such a component corresponds to the intersection of several such regions, or even to no anatomically well-defined region, but rather results from the complex interaction of diverse neural circuits. (Jenkins 2000: 65; emphasis added. See also Friston et al. 1996: 102-3, Chomsky 2004: 104)

The same is true even if large-scale process-based analyses of the type argued against above, were adopted:

(553) Although there is something dramatic in the statement that the ability to generate sentences lives in a particular cerebral center, there is no reason to suppose that the mapping between linguistic activities and brain areas is one-to-one. The state of the evidence at this point – the complicated patterns of selectivity observed after brain damage – does not warrant such a conclusion. (Grodzinsky 1990: 10-11; emphasis added)

This means that the computational system C_{HL} (or Universal Grammar) is "consistent with, although neutral to, the choice of a particular modular picture of neuro-anatomical organization" (Jenkins 2000: 69).

As argued in section 4.5, there are good reasons to not assume an undifferentiated 'language module' to be localized in a single anatomical area. Likewise, under a constrained definition of language, it is not everywhere in the brain. I shall argue, following many others, that language is implemented in the brain as a distributed network of modules, computational centres, or functionally segregated focal areas. One of these centres is especially important for syntactic computation, namely, *Broca's area* which will be the focus of section 4.7.

4.5 Lateralization and Localization of Function

There are four logically possible ways that language may be implemented (represented) in the brain:

(554) Language in the brain:

- a. Nowhere
- b. Everywhere
- c. In one place
- d. In several places.

The first answer, (554)a, 'nowhere' is clearly not an option under any (broad or narrow) definition of language; damage to the brain can lead to selective impairment of language (as in the various types of aphasia).

The second possibility, (554)b, 'everywhere', is also implausible – unless language is understood in the broad sense referred to in (548), but as also stated this is too broad a sense of the word to be of much use. Language in the narrow sense adopted here (syntax, lexical semantics, and phonology, see section 4.2 above and chapter 1, section 1.2.1) cannot be

everywhere in the brain. First of all, selective linguistic impairment would not be accounted for. Furthermore, the implication is that language acquisition is done by a general learning mechanism and hence dependent on general intelligence and vice versa. However, language is independent and distinct from 'general cognition', and impaired general intelligence need not have an impact on language, as is the case in Down's syndrome and William's syndrome (see Christensen 2001, section 4.2, for discussion). In other words, there is a double dissociation between language and intelligence. This is, of course, closely related to the notion of modularity: Language is a cognitive module, a somewhat self-contained subsystem of the human mind (see section 4.4).

This leaves us with the last two possibilities: (554)c, language is localized in one single area and (554)d, language is distributed over several areas. I shall argue that the latter is the case (see also section 4.8 below). (Again this is closely related to the definition of modularity.) A logical place to start is to find out whether language is represented in the right, the left, or in both hemispheres, i.e. left-, right-, or not *lateralized*. Studies of brain damage leading to language disorders, i.e. aphasia, have shown that the core aspects of language are normally in the left hemisphere (cf. e.g. Damasio 1992, Grodzinsky 2000*a*; see also section 4.7 below), as the correlation of aphasia and right-hemisphere damage is very rare, and encountered only if the patient suffers from early left hemisphere damage (cf. Bishop 1988). It appears, then, that the processes of syntactic computation, primarily Merge and Move (see chapter 1, section 1.2.2), are in the left hemisphere (but I shall argue the computation / derivation of syntactic representations activates a much more distributed network, due to the interfacing between syntax and other cognitive systems).

The discussion so far points to a localization of the core systems of language in the left hemisphere, and this is supported by results from tests where one hemisphere is anesthetized prior to brain surgery (this is called the *Wada test*, cf. Bishop 1988: 206). This is done in order to discover whether language functions are located in the left (as is almost always the case) or in the right hemisphere (very rarely the case). Anesthetizing the 'linguistically dominant' hemisphere causes language impairment (cf. Bishop 1988, Calvin & Ojemann 1994: chapter 3 and Donald 1991:80).

Right hemidecortication (removal of the entire cortex in one hemisphere) and lesions in the right hemisphere cause some pragmatic disorders, such as problems with understanding narratives, humour, and jokes (cf. Damasio 1992: 537; Deacon 1997; Schneiderman & Saddy 1988 and references cited there). Patients with right hemisphere damage understand the lexical and syntactic elements, the individual words and phrases, which means that it is neither a lexical semantic nor a syntactic deficit per se. They have problems with recalling the main events of a narrative, remembering the sequence of events, and crucially, "the schematic assignment of actions to agents" (Donald 1991: 82). What appears to be impaired, at least, is the ability to retain the roles of players in narratives. Even though this is at a supra-sentential level, it seems reasonable to assume that it also crucially dependent on the system needed for proper intra-sentential assignment of thematic roles (θ -roles, e.g. Agent, Theme, Experiencer, Beneficiary, Goal; see also chapter 1, section 1.2.4) by the right predicates. (See also Brownell 2000 for a discussion of the role of the right hemisphere in understanding metaphors.)

Schneiderman & Saddy (1988) present results from a study on patients with righthemisphere brain damage. In their study, they employ an *insertion test* where patients were asked to grammatically insert words or phrases into already complete and well-formed sentences. The items of the test are divided into two categories, namely, 'Shift' and 'Nonshift'; it is important to note that the term 'shift' used here does not refer to movement. In the 'Nonshift' category, patients are asked to insert a modifier of a noun phrase or an auxiliary verb; the insertion does not induce a 'shift' / change in the semantics/thematics of the sentence or in the syntactic categorial status or the constituents, such as in (555) (b is the result of the insertion of the underlined part into a).

(555) a. The sweater was mendedb. The wool sweater was mended

In some of the 'nonshift' examples, however, the semantics changed, such as when an adjunct (i.e. an optional modifier adjoined to vP) is inserted as in (556), but though the inserted phrase is assigned the additional θ -role of Recipient or Beneficiary, the other θ -roles remain the same (*her* = Agent, *drink* = Theme).

(556) a. (Cindy saw her) take his drink $(take \approx steal)$ b. (Cindy saw her) take his drink to him $(take \approx transport)$

In the 'Shift' category, on the other hand, the insertion does induce a change ('shifts') in θ -role; for example, in (557), the role of *her* changes from the Agent of *tell* to a role internal to the new Agent, *her husband*.

(557) a. (Susan heard) her tell a jokeb. (Susan heard) her <u>husband</u> tell a joke
In some of the 'shifted' examples, however, the insertion does not change the actual θ -roles; for example, in (558) below, *his drink* remains the Theme after insertion of *Howard* which is assigned the role of Recipient or Beneficiary:

(558) a. (Cindy saw her) take his drink $(take \approx steal)$ b. (Cindy saw her) take <u>Howard</u> his drink $(take \approx transport)$

The results show that right-hemisphere-damage subjects (RHD) do significantly better on 'nonshift' tasks than left-hemisphere-damage subjects (LHD) (who presumably have problems with the syntactic structure-building). Importantly, the converse is also found; RHD subjects do significantly worse on the 'shift' task, which involved a change of the θ -role of an argument.

Note the strong parallel between (556)b and (558)b; the difference between the two is called the *Dative Alternation* (or dative Shift, see section 5.3, example (622)). Interestingly, in an fMRI study by Ben-Shachar et al. (2004), sentences with structure corresponding to (558)b showed an increased activation in the inferior parts of the right frontal lobe compared to sentences with structure corresponding to (556)b. (I return to this study in section 5.3 below). The structure that is difficult for RHD subjects is the same that increases activation inn the right hemisphere. I shall argue that this difference in activation is due to a difference in how the θ -roles are assigned rather than θ -assignment per se.

Both the 'shift' and 'nonshift' tasks involve syntactic processing, and I shall argue that interfacing between core syntax and other cognitive domains is reflected in bilateral activation patterns with focal points determined by type of information involved, for example thematic information in the right-hemisphere.

Lesions in the right homologue of the language areas may also lead to *aprosodia*, a syndrome where the patient's speech is flat and lacks prosody (cf. Donald 1991: 80 and Calvin & Ojemann 1994: chapter 4). On the comprehension side, right-hemisphere damage may also cause an inability to understand intonation (Schneiderman & Saddy 1988).

According to Deacon (1997), the two hemispheres are optimized or specialized differently, not in terms of linguistic versus non-linguistic computation, but in terms of speed of computation. The right hemisphere is specialized in large-time (linguistic as well as non-linguistic) domains, which should account for the above mentioned problems with narratives and prosody for patients with right-hemisphere injuries. Prosody is a feature of the inter- or supra-sentential domain, as it spans the entire utterance regardless of the number of clauses.

The left side is specialized in short-time domains; linguistically, this includes morpho-syntax and phonology. In other words, the left hemisphere is speed optimized, which should account for the breakdown of syntax and morphology in left-hemisphere injuries (cf. Deacon 1997: 316).

Much in the same line as Deacon, but based on evidence from bilingual aphasics, Paradis (1998) places what he calls *implicit linguistic competence* in the left hemisphere. Regarding the right hemisphere, he states that "one can safely assume that the [right hemisphere] is crucially involved in the processing of *pragmatic* aspects of language use" (Paradis 1998: 422; emphasis added).

The deficits associated with right hemisphere damage are clearly neither (core) syntactic, (lexical) semantic, phonological, nor phonetic per se. That is, the core systems of language are intact. "Thus, the evidence is that this side of the brain has an important role in communication but makes no syntactic contribution to language use" Grodzinsky (2000*a*: 19). That is, the right side may not be crucially needed for the computation of linguistic structure but it plays a crucial role in the *interfacing* between the computational system and higher cognitive systems, including pragmatics and thematic representation. In fact, I shall argue that the right hemisphere homologue of Broca's area plays an important role in the integration of the thematic information, the θ -grid or the "who did what to whom" into the syntactic representation.

The table in (559) is a summary of lateralization of components of language (in a broad sense):⁷⁶

(559)	Lateralization
()	

Left	Right
Phonology, phonetics	Prosody
Lexical semantics	Pragmatics
Morphosyntax (Merge & Move)	Thematics

⁷⁶ Note that placing Merge and Move in the left hemisphere, presumably in the left inferior frontal gyrus (Broca's area) does not mean that all of syntax in localized there. That would be a gross simplification at all levels of abstraction. Furthermore, localizing these operations may even be premature in the first place, see the discussion in the paragraph above (561) in section 4.8 below.

4.6 Interfacing: Structure-to-Meaning Mapping

The core component of the language faculty is the computational system of human language C_{HL} (Chomsky 2001, 2004, 2005, to appear) – the language faculty in a narrow sense (see section 4.2 above and chapter 1, section 1.2). C_{HL} derives a set of symbolic representations, Phonetic Form (PF) and Logical Form (LF), sound and meaning, respectively (cf. the Saussurean sign), from a lexical array, the numeration. The derivation consists of recursive cyclic Merge and Move. PF and LF are interface levels, linguistic representations that are sent to the performance systems: Articulatory-Perceptual systems (AP) and Conceptual-Intentional systems (CI).

Various linguists have proposed that the mapping from syntax to meaning (LF) proceeds stepwise. That is, there are multiple interfaces (Platzack 2001*a*), spell-outs (Uriagereka 1999*b*) or phases (Chomsky 2001, 2004, 2005, to appear; see also chapter 1, section 1.2.5, and chapter 2, section 2.3.6); the syntactic tree maps onto a presupposition-focus structure (the Mapping Hypothesis, Diesing 1997; see also chapter 2, section 2.4.5), articulated CP-domain (left periphery phenomena, Rizzi 1997).

I shall focus on the derivation from lexical array to LF which is known as *narrow syntax*, the "generative engine" (Chomsky 2004: 108, Marantz, to appear: 14). At various points during the derivation, the computational system interfaces with higher cognitive systems. That is, partial syntactic representations are mapped onto thematic/semantic, grammatical, and pragmatic (information-structural / discourse related) representations (unless stated otherwise they are all normally subsumed under the label of LF).

(560) Structure-to-meaning mapping:



As argued in chapter 1, sections 1.2.1 to 1.2.5, the syntactic derivation or computation is (i) defined by the kinds of operations it consists of, namely successive cyclic and recursive Merge and Move, (ii) subject to constraints on computational economy (e.g. phases, Minimal Link Condition, Last Resort) and structure (e.g. constituency, X-bar/phrase structure, ccommand, the Extension Condition), and (iii) (sometimes) motivated by interfacing/mapping with e.g. information structure. Sometimes movement may be either triggered or blocked by something other than meaning in a broad sense, for example language-specific (parameterized) differences in head-complement order, affixation / cliticization, and EPP checking. (The interaction between syntactic constraints and mapping conditions is the topic of chapter 2 and 3.)

Assuming the biolinguistic computational approach and its empirically motivated narrow and explicit definition of language to be a promising candidate for a solution to the problems of Granularity Mismatch, (550), and Ontological Incommensurability, (551), (keeping the quotation in (549) in mind) the agenda for neurolinguistics can be stated as follows:

(561) How these computations are implemented at different levels of biological abstraction is the primary analytical question for neurolinguistics. (Poeppel & Embick 2004: 12)

4.7 Primary Region of Interest: Broca's Area

The first empirical localizationist models of language (functions are localized in special areas) are most often attributed to the work of the French surgeon Paul Broca (1824-1880) and the German neurologist Carl Wernicke (1848-1905). However, the later much vilified German neuro-anatomist Franz-Joseph Gall (1757-1828) the founder of phrenology, had in fact already argued that language was localized in the brain bilaterally in the areas of the frontal lobes immediately behind and above the eye sockets (Gall's area 33). The French doctor Marc Dax (1770-1837), argued in 1836 that language was left lateralized with making claims about the localization within the left hemisphere (cf. Gjedde 2004).

Broca discovered that symptoms of expressive aphasia were linked to damage to the third inferior frontal convolution of the brain (since called Broca's area). The implication of Broca's discovery was that language was a unitary skill associated with a single language area in the brain, the area that is now known as *Broca's area* (Broca himself did not make this conclusion; he placed language in the frontal lobes and considered the left lateralization in his

patients to be coincidental). This, however, was quickly modified by the discoveries by Wernicke, who found that symptoms of fluent aphasia could be linked to damage to a part of the first temporal gyrus, an area which is now known as *Wernicke's area*. In Wernicke's model of the brain, language was not conceived as a unitary system but as a complex of underlying systems, or rather processes, all localized in the brain (see Donald 1991: 45-48).

The primary (but not the only) region of interest here is Broca's area. This is motivated by the fact that lesions to Broca's area (Brodmann area 44/45, abbreviated BA44/45, see (563) below) lead to Broca's aphasia characterized by agrammatism: 'telegraphic' speech on the production side (e.g. Friedmann 2003, Friedmann & Grodzinsky 1997) and problems with comprehending *semantically reversible sentences* with syntactic movement that affects the order of θ -roles, i.e. Agent, Theme, Experiencer, etc. (e.g. Grodzinsky 2000*a*; for Danish, see also Christensen 2001).

Semantic reversibility means that both arguments of a transitive verb can be assigned either of the two thematic roles the verb assigns. For example, the verb *build* assigns two θ roles, an Agent, the 'builder', and a Theme, the 'thing built'. The sentences in (562)a and b are not semantically reversible because the 'builder', the Agent, has to be animate, and the 'thing built', the Theme, has to be inanimate. In contrast, the verb *kiss*, takes two animate arguments, a 'kisser', the Agent, and 'someone kissed', the Theme. As both arguments are animate, they are both possible Agents, they can both be 'kissers' and they can both be the Theme, the 'kissed'. (At least, the Agent has to be animate; the object of kissing can of course also be inanimate things, but if the Theme is inanimate the sentence is no longer reversible.) Thus, the sentences in (562)c and d are reversible, as both *Jack* and *Jill* can kiss and be kissed.

	Reversible	Movement	Problematic
a. Jack built the house	No	No	No
b. The house was built by Jack	No	Yes	No
c. Jack kissed Jill	Yes	No	No
d. Jill was kissed by Jack	Yes	Yes	Yes

(562) Semantic reversibility

The passive sentences in (562)b and d has movement of the Theme from its 'underlying' position as the object to the subject position, while the 'underlying subject', the Agent, is optionally merged as an adjoined *by*-phrase. There is movement and the order of θ -roles is reversed, but only (562)d are problematic for agrammatics because it is also semantically reversible. In agrammatism, according to the *Trace Deletion Hypothesis* TDH (Grodzinsky 1990, 1995*a* and *b*, 2000*a*, in press), traces in θ -positions (structural positions to which θ -

roles are assigned) are deleted from the syntactic representations. This means that a moved argument is assigned a θ -role because the chain that would normally connect it with the role assigned to it by the verb is broken, and in comprehension, agrammatics use non-syntactic knowledge to assign it a θ -role: semantics, pragmatics, and knowledge of the world; in addition they seem to apply a 'default strategy' according to which the first DP is assigned the role of Agent (DP₁ = Agent) (this is closely related to the notion of canonicity).

With semantically non-reversible sentences, it is straightforward as there is only one possible Agent (knowledge of the world includes the knowledge that, for example, houses cannot be 'builders'). In contrast, reversible sentences have two potential Agents, and without the syntactic chain to transmit the θ -role, agrammatics are basically forced to guess. The adjoined argument is arguably assigned the role of Agent by the preposition *by*, but the first DP is also assigned an Agent role by the 'default strategy', and as there cannot be two Agent θ -roles in the same clause, agrammatics choose between the two interpretations (Agent–Theme vs. Theme–Agent), sometimes correctly and sometimes incorrectly yielding a performance at chance level.

The connection between Broca's area and syntactic deficits related to syntactic movement phenomena is supported by studies on e.g. Chinese, Dutch, English, German, Hebrew, Italian, and Russian aphasics (see Grodzinsky 2000*a*, in press, for overviews).

Further support comes from neuroimaging studies on normal subjects which show that movement affecting the order θ -roles increases activation in Broca's area. This is found when contrasting **object relative clauses** to subject relative clauses (cf. Ben-Shachar et al. 2003 for Hebrew, Just et al. 1996 for English), *wh*-movement vs. *yes/no*-questions (cf. Ben-Shachar et al. 2004 for Hebrew; cf. also section 5.2 below), when **topicalization** with nontopic declarative clauses (Ben-Shachar et al. 2004 for Hebrew, Dogil et al. 2002 for German), and **scrambling** vs. non-scrambling (Röder et al. 2002 for German; see also Fiebach et al. 2005). I shall discuss some of these studies in detail in chapter 5, section 5.3, below.

In summary, damage to Broca's area leads to syntactic deficits; a clear indication that it is crucially involved in syntactic processing. Results from neuroimaging studies show that activation is increased in Broca's area in sentences with non-canonical word order compared to sentences with canonical word order. The hypothesis is that Broca's area is crucially involved in the computation of syntactic movement, at least the type of movement that changes the order of θ -roles – an anatomically as well as theoretically constrained hypothesis.



Top: inter-hemispheric surface; Bottom: left hemisphere; Left: Brodmann areas (BA) (from Woolsey et al. 2003: 12); Right: sulci (from Sobotta & Becher 1975: 4).

To test the hypothesis is to investigate sentences with syntactic movement that does not change the order of θ -roles, that is, phrasal movement that retains the relative order of the θ marked XPs but not necessarily the order relative to other constituents. However, it is generally difficult to find XP-movement that does not have consequences for semantic interpretation. For example, it makes a lot of difference which argument raises to subject or which constituent is topicalized or focalized. However, NEG-shift does not change the order of the θ -roles or affect the "who did what to whom". There is no difference in interpretation between *ikke...nogen* and *ingen* (cf. chapter 2, section 2.3.13.2). Movement of *ingen* to spec-NegP is required to license sentential negation (cf. chapter 2, section 2.4.2). In this sense, it is motivated by information-structure (scope). On the other hand, it is a syntactic requirement that EPP is checked on NegP, that is, that spec-NegP is filled. In any case, NEG-shift is not optional. The interesting question is whether Broca's area is also activated during computation of non-thematic movement.

4.8 The Distributed Syntax Network

The discussion of lateralization and localization, brain damage and neuroimaging could be taken to suggest that neuroimaging studies of syntactic movement show activation only in Broca's area. However, a brief look at the neurolinguistics literature on syntax (as well as e.g. semantics or phonetics) and the brain will show that things are more complicated. Activation is found is a number of areas even outside the 'classical' language areas, Broca's area and Wernicke's area. For example, Dogil et al. (2002) asked subjects to perform two reserialization tasks. One was structure-dependent: they had to reformulate subject-initial sentences such that they started with a different constituent than the subject, that is, a topicalization task (I return to topicalization in section 5.3 below). The other task was a list reserialization task where the subjects had to reorder a list of words such that the second word was moved to the first position, i.e. ABC \rightarrow BAC. When Dogil et al. (2002: 82) subtracted the re-serialization task from the topicalization task,⁷⁷ they found activation in "in the left dorsolateral frontal lobe, extending to Broca's area, and at the level of left temporal lobe, encroaching on Wernicke's area [...] anterior cingulate gyrus [...] and the cerebellum" as well as in the dorsal prefrontal cortex. They conclude that "the Structure-dependency of syntactic operations is controlled by a delineated network" (p. 83). This network, however, is not necessarily specific to syntax or even to language. "The coactivated cerebral-cerebellar network has been claimed to function as a working memory for time sensitive operations. [...] It is remarkable, however, that networks and structures usually connected with working memory are coactivated by a syntax-specific task. The dorsal prefrontal cortex (DPF) is exactly one such area that has always been associated with memory and almost never with language" (Dogil et al. 2002: 84) (see also section 5.4 below). The recruitment of the cerebellum may, however, have to do with *automation* rather than time sensitivity (though clearly these two factors are inter-dependent)⁷⁸. Automated processes include learnt and acquired as well as innate skills and reflexes that are processed below the level of consciousness (cognition and intention). "Roles of the cerebellum in cognitive functions are suggested by deficits induced by cerebellar lesions in cognitive planning, in practice-related learning and error detection, in judging time intervals, in rapidly shifting attention between sensory modalities, and in cognitive operations in three-dimensional space [...]" (Ito 2000: 159-160). Take for example the difference between wilfully reaching out for a glass and the

⁷⁷ This subtraction is actually not a subtraction of two minimally different conditions, that is, it is not a sufficiently constrained task difference and the result may reflect more than Structure-dependency, cf. section 5.1.2 below.

⁷⁸ Here and in the analysis below, I shall treat the cerebellum as an undifferentiated module. This is, of course, a gross simplification.

complex coordination of the muscles in the arm and hand controlling the elbow, hand and fingers, or the difference between, say, playing piano scales as an amateur and the effortlessness and rapidity associated with mastery. The crucial point, however, is this:

(564) The syntax network [...] is widely distributed in the human brain. The focal areas of the network (Broca's area, Wernicke's area, Cerebellum, DPF [dorsal prefrontal, K.R.C.], ACC [anterior cingulate cortex, K.R.C.]) are very strongly interconnected. (Dogil et al. 2002: 85)

Thus, while *linguistic* processing may recruit a range of cortical areas across the whole brain, *syntactic* processing is implemented as a distributed network of computational centres. In other words, "abstract function is localized in focal areas" (Dogil et al. 2002: 86). When tasks are made increasingly more fine-grained (taking into account fine syntactic distinctions), only a subsection of the whole large-scale linguistically recruited network will show up in subtraction results.

(It should be noted that I use the term 'activated' to refer to the *differential* activation between two minimally different conditions, unless stated otherwise, such that one has more activation in certain areas than the other; in other words "area X is activated in task Z" means "area X is more active than area Y in task Z".)

What we see is what Dogil et al. call a *vanishing network*: In lexically and syntactically more constrained tasks (I return to this in section 5.1.2 below), the areas activated "will probably be a part of the large-scale [speech, K.R.C.] network that we discovered, but the network itself will become 'invisible'" (Dogil et al. 2002: 87).

The distributed syntax network is compatible with the results from a wide range of other neuroimaging studies, e.g. Ben-Shachar et al. (2003, 2004), Cooke et al. (2001), Dapretto & Bookheimer (1999), Embick et al. (2000), Fiebach et al. (2005), Just et al. (1996), Newman et al. (2003), Röder et al. (2002), Wartenburger et al. (2004). I return some of these studies in section 5.3 below. Furthermore, I shall present data from an fMRI study I conducted on Danish syntactic movement supporting the network. The figure in (565) below illustrates the network, leaving much detail aside; the main focal areas are the left frontal gyrus (LIFG) including Broca's area and its vicinity, the left posterior superior temporal gyrus (LpSTG) including Wernicke's area and its vicinity, and their right-hemisphere homologues, as well as the dorsal prefrontal cortex, the cerebellum, and the anterior cingulate gyrus (on the interhemispheric surface, cf. the upper right image in (563) above). According to Damasio (1992: 537), damage to the cingulate gyrus leads to *akinesia*, difficulty in initiating movement (as in

Parkinson's disease) and a lack of will to communicate, linguistically as well as with gesture and facial expression (as is often the case in autism), hence, the term *mutism* does not entirely cover the phenomenon.





Some studies have even indicated that within Broca's area there may be further subdivision of function. For example: Superior part: semantic/thematic aspects, inferior part: syntactic processing (Dapretto & Bookheimer 1999, Fiebach et al. 2005: 89, Newman et al. 2003: 304); "although a larger portion of BA44 seems to support aspects of syntactic working memory, the inferior tip of BA44 and the frontal operculum are required specifically for local phrase-structure building" (Friederici 2002: 81). Poeppel & Embick (2004: 10) places not only syntactic structure building but also computation recruited in the phonological process of spell-out: "Two components essential to syntax are the creation of hierarchical structures and a process that linearizes these hierarchical structures. These are the kinds of computations that can be abstracted from syntax in the broad sense, and which are perhaps associated with different subparts of the IFG" (Poeppel & Embick 2004: 10). Though extremely interesting, I shall have to disregard these further sub-divisions in my discussion below.

Merge and Move, the operations that build hierarchical syntactic structure, may also be located in a sub-part or sub-parts of Broca's area. Though this appears to be true, the exact neural detection of these computational operations still seems to escape localization / implementation. However, this is also true for other and much simpler problems; for example, as Chomsky (2000*a*: 14) notes, the ability to recognize a continuous vertical line "is a mystery that neurology has not yet solved". He continues:

(566) As far as I am aware, the neural basis for the remarkable behavior of bees also remains a mystery. This behavior includes what appear to be impressive cognitive feats and also some of the few known analogues to distinctive properties of human language, notably the regular reliance on "displaced reference" – communication about objects not in the sensory field [...]. The prospects for vastly more complex organisms seem considerably more remote. (Chomsky 2000a: 14)

I am less pessimistic about the prospects of neurolinguistics as a whole. The specific lowlevel operations involved in the derivational computation (see chapter 1, section 1.2.2) may still be beyond present methods, but problems at slightly higher levels may still be solvable. I shall argue that different activations in the network in (565) reflect differences related to the interfacing between C_{HL} and other higher systems.

4.9 The Domain Hypothesis

In what follows I shall argue that differential activation in the distributed network recruited in syntactic processing reflects the computations associated with the syntactic domain targeted in the task difference – that is, the *interfacing* between the syntactic target domain and higher cognitive systems (the conceptual-Intentional interface, CI, see chapter 1, sections 1.2.1, 1.2.4, and 1.2.5). That is, there is a *syntactic domain × movement operation* interaction effect. First of all, there has to be a movement contrast, and second, there has to be a difference in target domains. The effect will thus be the result of the interaction of [+/-Movement] and [Target=CP/IP/vP]. Briefly, movement that targets the CP-domain will increase activation in Broca's area (relative to conditions differing minimally in not having such movement), for example *wh*-movement, topicalization, and, I shall argue (see section 5.3 below), 'long' scrambling in German. Movement targeting the IP-domain, e.g. NEG-shift and 'short' scrambling, on the other hand, does not appear to increase activation anywhere (so far). (On the motivation for NEG-shift, see chapter 2, section 2.4.2.) Finally, VP-internal operations, including the dative alternation and θ -role assignment increases activation in the right frontal system including the right-hemisphere homologue of Broca's area (BA44/45) and the insula:

(567) **The Domain Hypothesis**



(Compare (567) to (560) above.) The model combines two findings: (i) that left hemisphere damage leads to specific syntactic impairments, agrammatism, which affects some syntactic movement, namely those that target the CP-domain; (ii) that left hemisphere damage leads to semantic impairments that affects what is in linguistic theory as θ -theory, namely the assignment of thematic roles to arguments and integrating them into event structure, which is internal to the VP-domain; (iii) that these two targets domains have different neural activation patterns in fMRI studies on normal subjects. I shall first present data from my own fMRI study supporting the hypothesis before presenting data from other studies to back it up. It seems that the IP-domain still escapes detection, both in the brain and in terms of empirical motivation for formal devices such as phases in syntactic theory.

An otherwise obvious approach to syntactic movement and the brain is working memory (to which I return in section 5.4 below). First of all, because moved constituents must be kept in memory until their 'base-position' is accessible for interpretation, and secondly, because Broca's area is sometimes associated with working memory (linguistic as well as non-linguistic). However, the Domain Hypothesis contrasts with a simple working memory approach which would predict a more linear relationship such that more or longer movement would increase activation more in Broca's area. In section 5.2, , I shall present results from an fMRI of my own supporting the hypothesis before reviewing results from the literature which, I argue, is also compatible with the Domain Hypothesis (see section 5.3).

5 Syntax in the Brain

In chapters 2 and 3 I have provided first a descriptive corpus-based account of NEG-shift and then presented a comparative syntactic analysis from a formal perspective. In this chapter, I shall present data from neuroimaging studies of syntactic movement (and hence, computation and abstract empty categories) that supports the hypothesis that syntactic processing is implemented in the brain as a widely distributed network of computational centres or modules, and that activation patterns reflect the interfacing between different syntactic domains and higher cognitive systems – a domain \times movement interaction effect. Together the results indicate that a monolithic working memory approach to syntactic movement is insufficient, and that a linguistically constrained hypothesis is required: the Domain Hypothesis.

But first, in section 5.1, I consider a number of methodological issues, inlcuding neuroimaging, subtraction methods, fixed- and random-effects analyses, and corrected and uncorrected results, followed by a brief look at the glass brain representation.

5.1 Some Methodological Issues

5.1.1 On Neuroimaging

Much of our current knowledge about the relationship of language and the brain is based on the study of aphasia, which in turn was originally only based on autopsies of dead aphasic patients. However, modern technology provides researchers with new tools, which allow them to see inside the heads of living people without actually opening the skull. We can now see not only the morphology of the brain but also images of the actual workings of the living brain. There are now a number of different methods of brain imaging, such as fMRI *functional magnetic resonance imaging* (used in the present), PET *Positron Emission Tomography*, EEG *Electroencephalography*, ERP *Event Related Potentials* (or *Evoked Potentials*) (see Volkow et al. 1997 for an overview). Here, I shall limit the discussion to two methods: fMRI and PET.

Both methods exploit the fact that activation in a brain area demands more oxygenated blood than inactive areas. So, by measuring the cerebral blood flow (CBF) we get a glimpse of the workings of the brain. The two methods differ in the way the blood flow is measured.

In PET the test person is injected with a small quantity of mildly radioactive water that quickly circulates to the brain. When the radioactive matter decays it emits a positron, the positive version of an electron. The positron immediately collides with an electron annihilating both and sending out two gamma rays in opposite directions. These rays are picked up by detectors surrounding the test person's head and a computer calculates the exact spot were the collision and annihilation occurred. During scanning all the collision points are accumulated and are then used to compute a picture of a slice of the brain's entire activity. The more active areas are shown in yellow and red colours on the computer screen and the lesser to inactive ones in green and blue. A drawback of PET, apart from the injection of the quickly decaying radioactive material limiting the overall time window to app. 2 minutes, is the time it takes to retrieve the data: around 30 seconds for each scanning. This seriously weakens the temporal resolution but also limits the types of tasks that can be tested under PET.

Functional magnetic resonance imaging, or fMRI, is not based on injecting people with radioactive material but on the fact that the brain uses the oxygen in the blood. Here, the test person is placed inside a very powerful electromagnet, which pulls the atoms in the brain into alignment with the magnetic field of the scanner. Then radio waves are sent through the brain bringing the atoms out of alignment with the magnet for an instant. When the atoms realign with the magnet they send out a tiny radio signal, which is distinct in frequency for every type of molecule. Receivers around the head then pick up the signals.

What is measured is the *Blood Oxygenation Level Dependent*, or *BOLD* signal. It exploits the fact that neural activation requires oxygen. Haemoglobin has different magnetic properties depending on whether is combines with oxygenated or with deoxygenated blood. By comparing the signals of the blood carrying the oxygen (or rather the oxygenated haemoglobin in the red blood cells) with the deoxygenated blood, a computer can calculate which areas receive more oxygenated blood (i.e. more oxygen) and, hence, which areas are activated. However, some studies have shown that the BOLD signal may also correlate with glucose consumption rather than oxygen consumption (for reviews, see Jueptner & Weiller 1995, Heeger & Rees 2002, Lauritzen 2001, 2005).

The function of the increased blood flow is to provide the substrates for energy metabolism, namely, glucose and oxygen. Despite the unresolved issue of the exact nature of the BOLD signal, it is a standard method in neuroimaging.

With regards to temporal resolution fMRI is superior to PET: only 3 seconds for a whole brain scan, and no overall time window to consider. But there are drawbacks as well: First of all, the magnet produces an extremely loud noise with a volume above 90 dB. PET detects activity in all areas with roughly equal sensitivity, whereas the signal in fMRI is affected by cranial magnetic fields in some areas, especially around e.g. the ear canals (cf. Rugg 1999). Where such areas are considered PET is superior to fMRI.

5.1.2 Constrained vs. Unconstrained Task Subtractions

As discussed in section 4.8 above, task subtractions that ignore fine-grained distinctions and complexity tends to give much greater and more widespread activation. In other words, *unconstrained* subtractions⁷⁹ will show the whole or large portions of the distributed network in which the computation is implemented. For example, in the present fMRI study, it is possible to group the data into two categories, namely, language (semantic judgment) and (looking at) numbers. When the 'number' condition is subtracted from the 'language' condition, the result is massive activation, especially in the classical language areas, the cerebellum, the dorsal prefrontal cortex, and in the right-hemisphere homologues of Broca's area (R-IFG) and Wernicke's area (R-pSTG):

(568) 'Language' > 'Numbers'



Right hemisphere

Left hemisphere

The images are impressive. The problem is, however, that there are too many uncontrolled parameters and hence the result is, at best, inconclusive. Clearly a subtraction like this ignores a whole range of important task differences, and what is more, the two conditions can in no way be taken to be equal in complexity. Furthermore, what is activated in the 'language' condition may be due either to syntactic, semantic, pragmatic, and/or phonological processing, and it is impossible to see how and which ones. Nonetheless, what we see is (aspects of) the language system in action as a function of a rather unconstrained task difference (and it may therefore me useful as a large-scale localizer).

Linguistically *constrained* task subtractions, on the other hand, show that abstract function is localized in focal areas (cf. section 4.8 above). In the next sections I present the

⁷⁹ Technically speaking, they are not really subtractions between two conditions, say, A and B. The results are not really subtracted from each other. The analytical software (here SPM2), looks for areas where there is more activation in condition A than in condition B given certain predefined thresholds of significance. The activation pattern reflects the extra neural activation needed for computation in condition A compared to the activation needed in B.

imaging results from the fMRI study outlined above. First I present the result from a more constrained subtraction, namely, the main *movement* effect: subtracting the conditions without the extra XP movement, i.e. B: NEG-adv and D: *yes/no*-questions, from the conditions that have movement, namely A: NEG-shift and C: *wh*-questions. Then I move on to investigate how the target domains interact with the movement effect, making the subtractions even more fine-grained. The activation patterns confirm the Dogil et al.'s (2002) hypothesis of the 'vanishing network': In more constrained tasks, only parts of the network will light up and "the network itself will become 'invisible'" (cf. Dogil et al. 2002: 87).

5.1.3 A Note on Fixed-Effect and Random-Effect Analyses

There are basically two ways of looking at the imaging data; one is called a fixed-effect analysis (FFX), the other is called a random-effect analysis (RFX).

The fixed-effect analysis "assume that each subject makes the same, fixed contribution to the observed activation and therefore discount random variations from subject to subject" (Friston et al. 1999: 386). In other words, when comparing different subjects it assumes that all the subjects perform more or less the same way and the result shows the areas that are activated on the average across the subjects. Likewise, when comparing multiple sessions on the same subject, it is assumed that subjects always perform in more or less the same way.

In the random-effect analysis one is looking for the areas that are activated in more or less much the same way in all the subjects (or, in case of one subject but multiple sessions, in all the sessions)

There is a crucial difference between the two types of analysis. A fixed-effect analysis may yield significant results when one or a few of the subjects show a lot of activation though the rest of the subjects may not show any increased activation. On the other hand, random-effect analyses may sometimes be too constrained too yield a result because "the random-effects analysis confers generality, but with a concomitant loss of sensitivity due to the inevitable low degrees of freedom" (McGonigle et al. 2000: 732). Furthermore, as argued by McGonigle et al. (2000), even within subjects there is variation in the neural response to the same experimental stimuli which means that the random-effect analysis needs further development before being realistically applicable. As it is, it may still be too powerful as such variation in locus of activation, at least with small activation clusters, both within but certainly also between subjects, may not survive the threshold of significance.

Fixed-effect analyses are generally more sensitive. However, "the price one pays for the apparent sensitivity of fixed-effect analyses is that the ensuing inferences pertain to, and only to, the subjects studied" (Friston et al. 1999: 385).

None of them are perfect. They both have drawbacks as well as advantages, but both are completely legitimate ways of analyzing data:

(569) Both analyses are perfectly valid but only in relation to the inferences that are being made: Inferences based on fixed effects analyses are about the particular subject[s] studied. Random-effects analyses are usually more conservative but allow the inference to be generalized to the population from which the subjects were selected. (Friston 2003: 32)

The choice between the two should depend on what is studied, how many subjects there are, and whether or not the results are to be compared to (and be compatible with) other findings and imaging results. In the present study there are only 11 subjects, which is close to being insufficient for a random-effects analysis. I shall therefore apply the fixed-effect analysis. I shall also provide brief random-effects analyses for completeness, but only when there is significant activation in the fixed-effects analysis, and though there is much less activation and though the clusters are much smaller, the important focal points are still active under in the random-effects analysis.

As I shall show, the results are convergent with the results from a range of neuroimaging studies as well as findings from lesion studies (see also sections 4.5 and 4.7 above).

5.1.4 Corrected and Uncorrected Levels

In an experiment, if there is "an a priori anatomical hypothesis concerning the experimentally induced effect at a single voxel, then we can simply test at that voxel using an appropriate α level test" (Nichols & Holmes 2003: 12). However, in neurolinguistic studies there is expected to be significantly more activation than in a single voxel, the localization of which would constitute quite a problem in itself. With more voxels, some statistical correction has to be applied:

(570) If we don't have such precise anatomical hypotheses, evidence for an experimental effect must be assessed at each and every voxel. We must take account of the

multiplicity of testing. Clearly 5% of voxels are expected to have p-values less than α = 0.05. This is the essence of the multiple comparisons problem. In the language of multiple comparisons, these p-values are uncorrected p-values." (Nichols & Holmes 2003: 12)

The corrected level means corrected for multiple comparisons of independent voxel activations. Without such correction, a threshold of p=0.05 would give a 5% chance for activation (whether or not this activation is real or just random noise) for each and every voxel.

The level of significance corresponds, in informal terms, to lowering or raising the water level in a sea with islands and underwater mountains. The lower the water level, the more and bigger islands and mountain peaks, and the higher the water level, the less islands and peaks. At the extremes, there is all land at the one (low) end, and all water at the other (high) end. Likewise, with a low threshold and/or less conservative statistical method, there will be more activation than with a higher threshold and/or more conservative method.

I shall use the less conservative False Discovery Rate (FDR) method instead of the very conservative Family-wise Error (FWE) method. In FDR, as opposed to FWE, a certain amount of noise is allowed in favour of not weeding out potential activation that is wrongfully interpreted as noise. The False Discovery Rate controls "the expected proportion of false positives amongst those voxels declared positive (the discoveries)" (Worsley 2003: 5; see also Nichols & Holmes 2003).

The use of uncorrected p-values is, however, appropriate when one has an a priori idea of where the activation will be: "With an **anatomically constrained hypothesis**, about effects in a particular brain region, the uncorrected p value [...] can be used to test the hypothesis." (Friston 2003: 17; emphasis added. See also Friston et al. 1996: 99). The requirement that it be anatomically constrained means that the observed uncorrected activation and the conclusions drawn from it have to be convergent with other more solid (corrected) results. Thus, this very liberal method is only legitimate when specific activation clusters are expected and no conclusions can be drawn from activation outside the expected areas.

5.1.5 The Glass Brain Representation

The result of a subtraction can be represented in what is called a 'glass brain'. The glass brain representation is a right-angled projection of the activation clusters. As the name implies, it is a look through a transparent brain where only the activation clusters are visible as grey and

black spots. So, for example, from the sagittal view from the right, it looks as if all the activation in the brain occurs on the surface of the right hemisphere. However, when one compares it with the axial and the coronal views, it becomes clear that that the 'blobs' are in fact in both hemispheres and not only on the surface.⁸⁰

The centre of the brain has the coordinates (x, y, z) = (0 mm, 0 mm, 0 mm); right is +*x*, left is -*x*; up is +*z*, down is -*z*; front is +*y*, and back is -*y*. The *sagittal view* (from the right) is in the *x*-plane and show the *y* (length) and *z* (height) coordinates, the *coronal view* (from the back) is in the *y*-plane and show *x* (width) and *z* (height), and the *axial* or *transverse view* (from above) is in the *z*-plane and show *x* (width) and *y* (length).

Threshold = 10 means that all clusters smaller than 10 voxels are filtered out; a voxel is a three dimensional pixel in the computed model of the brain (in the study in section 5.2 below, voxel size is 2x2x2 mm). The data is corrected for multiple comparisons with a statistical significance threshold of p<0.05.)

(571) Glass brain



⁸⁰ The glass brain in (571) is the result of the main movement effect in the fMRI study in section 5.2.3 below.

5.2 NEG-shift and Wh-movement: an fMRI Study

5.2.1 Design and Setup

I constructed the 2-by-2 factorial experimental design illustrated in (572) below. All four conditions (A-D) involve an operator that license NPIs: in NEG-shift (A) it is the moving negative object, in (B) it is the negative adverbial operator *ikke* 'not', in (C) it is the moving *wh*-object, and in (D) it is a phonologically empty operator OP in spec-CP. Along the horizontal axis the conditions involve merge/move operations targeting either spec-NegP in the IP-domain, (A) and (B), or spec-CP, (C) and (D). Along the vertical axis, the distinction is between movement of the operator, either a NegQP object as in (A) or a *wh*-object as in (C), and insertion (Merge) of an adverbial operator in (B) or an empty question operator in (D).

(572) Experiment design

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)		
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)		

Each condition was constructed both as well-formed sentences and semantically anomalous sentences, as in (573) and (574) below. (For the full set of input sentences, see appendix C; on the analysis of NEG-shift, see chapter 2; on *wh*-movement, see chapter 1, section 1.2.2, and chapter 2, sections 2.3.3 and 2.3.9.)

(573)	(A)	Konen	har	vist	ingen	sko	haft	(OK)
		Wife-the	has	I-guess	no	shoes	had	
	(A)	Konen	har	vist	ingen	ideer	spist	(Anomalous)
		Wife-the	has	I-guess	no	ideas	eaten	
	(D)	Vonon	har	ikko ba	ft noge			(OK)
	(D)	Wife-the	has	not had	d any	shoe	es	(0K)
					_			
	(B)	Konen	har	<u>ikke</u> sp:	ist no <u>c</u>	gen ide	eer	(Anomalous)
		Wife-the	has	not eat	ten any	/ ide	eas	

- (574) (C) <u>Hvilke</u> sko har konen ikke haft? (OK) Which shoes has wife-the not had
 - (C) <u>Hvilke</u> ideer har konen ikke spist? (Anomalous)
 Which ideas has wife-the not eaten
 - (D) Har konen ikke haft nogen sko? (OK) Has wife-the not had any shoes
 - (D) Har konen ikke spist nogen ideer? (Anomalous) Has wife-the not eaten any ideas

In the anomalous sentences, either the object (53.33%) or the subject (46.67%) induced a violation of the selection restrictions of the verb, e.g. with *korn* 'seed' as the object of *høre* 'hear' or *ideer* 'ideas' as the object of *spise* 'eat', or with *æsken* 'the box' as the subject of *finde* 'find' or *fuglen* 'the bird' as the subject of *købe* 'buy'.

The relevant partial structure of the four types is given below in (575) for conditions (A) and (B), and in (576) for conditions (C) and (D).

$$(575) \quad (A) \quad \begin{bmatrix} CP & Subj & Aux_{fin} & [FinP & t_{Subj} & Adv & [NegP & [ingen & NP]_{Obj} & [\nu P & t_{Subj} & Verb & t_{Obj} &] \end{bmatrix} \end{bmatrix} \\ (B) \quad \begin{bmatrix} CP & Subj & Aux_{fin} & [FinP & t_{Subj} & [NegP & ikke & & [\nu P & t_{Subj} & Verb & [nogen & NP] &] \end{bmatrix} \end{bmatrix}$$

(576) (C)
$$[_{CP} [\underline{Hvilke NP}]_{Obj} Aux_{fin} [_{FinP} Subj [_{NegP} ikke [_{\nu P} t_{Subj} Verb t_{Obj}]]]]$$

(D) $[_{CP} OP$ Aux_{fin} [_{FinP} Subj [_{NegP} ikke [_{\nu P} t_{Subj} Verb [\underline{nogen NP}]]]]]

During scanning, the sentences were presented visually projected onto a screen with an interval of 4 seconds (event time = 4 s.). The subjects were asked to judge whether the sentences were well-formed or anomalous and to press left or right, respectively, on a response box fastened to their right hand. The real parameter (+/-movement) was thus 'hidden' (they were not asked to attend to the difference).

The ratio between well-formed and anomalous sentences was 3:1 (25% anomalous) in order to avoid chance bias (i.e. guessing). The stimuli were presented in blocks of four sentences of the same type (A, B, C, or D). Within each block, 0, 1, or 2 sentences were anomalous. There were 15 blocks of each type (A, B, C, or D) which gives a total of 60 sentences (tokens) of each type (45 well-formed and 15 anomalous per type), an overall total of 240 sentences (180 well-formed and 60 anomalous):

	0 anomalous						
1	\checkmark	\checkmark	\checkmark	\checkmark			
2	\checkmark	\checkmark	✓	\checkmark			
3	\checkmark	\checkmark	✓	\checkmark			
4	\checkmark	\checkmark	\checkmark	\checkmark			
5	\checkmark	\checkmark	\checkmark	\checkmark			

(577) Anomaly distribution (\checkmark = OK, * = anomalous)

	1 ai	noma	alous	5
6	*	\checkmark	\checkmark	\checkmark
7	~	*	~	>
8	~	\checkmark	*	✓
9	~	✓	✓	*
10	*	\checkmark	\checkmark	\checkmark

	2 anomalous						
11	*	~	~	*			
12	✓	*	✓	*			
13	✓	*	*	\checkmark			
14	*	\checkmark	*	\checkmark			
15	*	*	\checkmark	\checkmark			

All sentences contained six words to avoid bias due to different number of words. All were constructed in the present perfect tense, namely, the auxiliary har 'has' and the perfect participle of a main verb. This was motivated by the results from a prior study (with 13 test subjects) which showed a correlation between response time and the number of words. Interestingly, there was no significant difference (p>0.20, one-sided) in response time between sentence with four words and sentences with five words, whereas the difference between five and six words was significant (p<0.0003, two sided). The difference between six and seven words was also significant, but not nearly as strongly so (p=0.031, one sided; the two-sided t-test did not reveal a significant difference). The significant difference between five and six words correlated with the absence and presence of an auxiliary verb, respectively. In both the four-word and five-word sentences there was no auxiliary verb (here the difference in between a pronominal object, *dem* 'them' and a quantified object, *ingen/nogle* 'no/some' + an NP), while both six-and seven-word sentences did have an auxiliary. The difference between six and seven words was the difference between *ingen* and *ikke...nogen*; in section 5.2.2 I show that the difference between ingen and ikke...nogen is not significant when the number of words is kept constant. Thus, there appears to be a correlation between the number of words and response time. However, the type of the word that increases the number also seems to be important.

All conditions are constructed using the same lexical material as far as possible; some elements such as *ingen*, *vist* and *hvilke* are by necessity unique to certain conditions. In the (A) condition (NEG-shift), an additional adverb had to be inserted in order to make it six words long (recall that the difference between *ikke...nogen* and *ingen* necessarily also includes a difference in number of words: the former has two words, whereas the latter has one). In all the (A) sentences this adverb was *vist*, a small discourse particle-like adverb meaning something like 'I guess'. Admittedly, this is a potential weakness as the lexical item should have been varied in the sentences to even out any potential lexical influence. Otherwise, contrasts (A vs. B and C vs. D) were kept as minimal as possible in order to

isolate the movement effects (that is, to keep task subtractions constrained, cf. section 5.1.2 below).

In addition to the four linguistic task conditions, the experiment included a 'dummy' condition (X) where the subjects did not have to do anything but watch numbers count down from 4 to 1. Each number presented for four seconds, thus filling as much time as a block of four sentences. This was included to avoid fatigue.

In order to avoid any potential contextual confounds, the blocks were pseudorandomized (both internally and externally) as illustrated in (578) below (read from left to right; for example, B1 = condition B, 1 anomalous; A2 = condition A, 2 anomalous, etc.):

B1	A2	D0	C1	Х	D0	B1	A0	C2	Х	A0	C2	D0	B1	Х
D2	C0	A1	B0	Х	A1	D1	B2	C0	Х	B1	C2	D2	A2	Х
C0	A1	D2	B0	Х	C1	D2	A1	B2	Х	D0	A2	C1	B0	Х
A2	B0	C2	D0	Х	C1	D2	B1	A0	Х	D1	B0	C1	A0	Х
B2	D1	A2	C0	Х	B2	D1	C0	A1	Х	D1	A0	B2	C2	Х

(578) Pseudo-randomized block sequence

The experiment was performed at the MR Research Centre, Skejby Sygehus, Aarhus University Hospital, on a GE Horizon Echospeed LX 1.5 Tesla clinical MR scanner (Signa SR120).

The scan volume consisted of 40 slices (thickness = 3 mm, spacing = 0) which covered the entire brain, including the cerebellum. TR 'time to repeat', the time it takes to scan the full set of slices once, also called a phase, was set to 3 seconds. Note that TR is different from event time (4 seconds) which means that during each event the scanner acquires more than a full set of slices, namely, 1.3333 sets. Having a TR that is not equal to or a simple multiple of the event time has the advantage that the hemodynamic response function (HRF) will be sampled asynchronously, that is, the y value on the curve of the function will be read off at different x positions (cf. Henson 2003: 18 and figure 8). Alternatively, with TR = event time, the BOLD function would be read off at the same point every time, and potentially the value at this particular point the value could be, say, zero, which would give the perhaps wrong impression that there is no signal.

The difference between TR and event time is illustrated in (579) below which shows the timing across a single block: There are four sentences, four events, of a total of 16 seconds which is not divisible by 3 (i.e. TR). The shaded and white sequences are full brain scans (TR). Each block is scanned 5.3333 times but the onset of the first full scanning is 'jittered' such that there are three different 'starting points': at 0 seconds (the TR marked α_1 in the A

condition in (579)), at 1 second (the TR marked β_1 in the C condition in the illustration), and at 2 seconds (γ_1 in the B condition).

(What is also evident is that TR=3 is not really optimal because there are only three sampling points; an even better TR would be, for example, 2.931 or 3.137.)

Real time (seconds)	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Events (sentences)	[5	Sente	ence	1]	[\$	Sente	ence	2]	[\$	Sente	ence	3]	[5	Sente	ence	4]
TR (A)		α_1			α_2			α3			α_4			α_5		
(B)				γ_1			γ_2			γ3			γ_4			γ5
(C)			β_1			β2			β3			β4			β5	
(D)																
(X)																

(579) Timing

Total fMRI scan time for each subject was 20 minutes which is 400 full brain volumes. In addition, at the beginning of each fMRI session, eight dummy acquisitions were made (brain scans that are not included in the calculations) to allow the magnetic field to get into alignment.

Eleven male native speakers of Danish, aged between 26 and 35 years (mean = 31.5) participated in the study. They were all right-handed and with no medical history of mental deficits or neurological trauma.

The presentation software was tailor-made especially for the experiment. It projected sentences on-screen aligned to the centre with pre-specified intervals (i.e. event time = 4000 ms.); tests were made to ensure that the program ran in actual real-time. The text was set using the *Arial* font which is a clear-cut type (sans serif) with no ornamentation. The program recorded the subjects' responses (marking whether the actual response is the same as the predicted response) as well as response times. During the first 700 milliseconds, response was suppressed in order to make sure that the response (right or wrong) could not be attributed to a 'spill-over' of response from the previous event. For example, if a subject response will be given to event 2 once the time window of 4 seconds has passed and the next event begins. Suppression time was based on pre-experimental test runs where response time never went below 700 milliseconds.

The imaging data was analyzed in *SPM2* (*Statistical Parametric Mapping*, Wellcome Department of Imaging Neuroscience, University College London⁸¹), a graphic interface add-on to MathWork's *MatLab*⁸².

When comparing imaging results different people some prior manipulation of the raw data is necessary. First of all, the data slices have to be *realigned* (turned to fit each other) to correct for artefacts due to the test person's movements during scanning. Second, the images have to be *normalized*. All brains are slightly different in size and shape and in order to compare them, the images are adjusted to fit into a standard shape and size, a 3D space called the *Talairach Space* (Talairach & Tournoux 1988). Finally, the data is *smoothed* (in the present case with a kernel of 7mm), which means that the activation patterns are corrected for random variation in the signal intensity (strength of activation).

Activation clusters were analyzed using the MNI Space Utility (The PET Lab, Institute of the Human Brain, St. Petersburg, Russia⁸³).

5.2.2 Behavioural results

Veridicality, the possibility of having a truth value did not influence judgments. Anomalous sentences were judged as such, regardless of the fact that many of them are always true, e.g. *she didn't eat any ideas*. That is, subjects systematically responded as predicted and, importantly, there is no significant difference between well-formed and anomalous sentences (p=0,52). Among the errors I have included the instances were subjects did not provide an answer, either because they were out of time or because of technical difficulties with the infra-read transmitter. This means that more instances are included as errors than were actually performed which offers some explanation of why performance is not 100% correct. The important point is, however, that in spite of the inclusion of these errors performance is still very close to ceiling level, and there is no significant difference between well-formed and anomalous sentences.

⁸¹ <u>http://www.fil.ion.ucl.ac.uk/spm/software/spm2/</u>

⁸² <u>http://www.mathworks.com/</u>

⁸³ http://www.ihb.spb.ru/~pet_lab/MSU/MSUMain.html



The differences in correct performance between A (NEG-shift) and B (NEG-adv) and between C (*Wh*-question) and D (*yes/no*-question) were not significant either (p>0.66 and p>0.90, respectively).

There were also no significant differences in reaction time (RT) between any of the conditions:

Condition	Туре	Mean RT	Difference	<i>p</i> -value
		(ms.)	(ms.)	
Α	NEG-shift	2413.43	41,52	>0.25
В	NEG-adv	2454.95		
С	Wh-question	2427.70	15,80	>0.66
D	yes/no-question	2411.90		
AC	+Movement	2420.57	12,86	>0.61
BD	-Movement	2433.43]	

(581) Reaction time

As there are no significant differences in performance or in reaction time, it can be concluded that there is no difference in task difficulty either (difficulty is held constant).⁸⁴ Or put differently, the imaging results cannot be attributed to differences in task difficulty, and with all other factors kept as constant as possible, it is reasonable to assume that the isolated effect is attributable to syntactic movement.

⁸⁴ The previous study referred to in section 5.2.1 also showed that response time and error level correlated with the type of anomaly. The syntactic anomaly was a selection violation where an intransitive verb has an unlicensed object (it is neither selected not θ -marked), such as *she didn't sleep any money*. The semantic anomaly was of the same type as the present study, for example, *I didn't bake any damages*. There was a significant difference in response time such that the subjects responded significantly slower (p<0.05, one-sided ttest) to the semantic violations than to the syntactic violations; this is compatible with Electrophysiological results from ERP studies (see e.g. Friederici 2002 and Hagoort et al. 1999 for overviews). There was also a significant difference in correct performance between the two conditions (p<0.00002), though performance was close to ceiling in both: 99.6% correct on the syntactic anomaly, 94.5 on the semantic anomaly. (Here errors due to no response were excluded from the analysis.)

5.2.3 Main Effect: Movement (AC>BD)

When the data is split along the +/-movement axis, i.e. the vertical axis in (582) below, the result is a constrained subtraction, though not completely constrained as the two types of movement are pooled together and therefore the difference between the two conditions is not minimal. The result reflects the extra neural activation needed to compute the syntactic movement.

In the table in (582) below (repeated from (572) above), the conditions marked by the broken rounded rectangle (B and D) are subtracted from those marked with an unbroken rectangle (A and C).

(582)

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)		
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)		

The main movement effect is given in the glass brain in (583) below, and the specification of the activation clusters is given in (584). (For full FFX activation cluster tables, see appendix D.)

(583) Main movement effect (AC>BD)





FFX (AC>BD), FDR p<0.05, Threshold = 10

#	Area	Brodmann area	Local max	Size
		(BA)	$(\mathbf{x}, \mathbf{y}, \mathbf{z})$	(voxels)
1	L-cerebellum		-32, -82, -32	63
2	L-cerebellum		-40, -54, -44	44
3	L-front: SFG, MFG	6/8	-4, 24, 58	31
4	L-front/temp: STG, PrCG, IFG	13/22/38/44/45/47	-50, 20, -8	433
5	L-sub-lobar, putamen		-24, 0, 6	59
6	L-temp: MTG, ITG	20/21	-56, -10, -18	290
7	L-temp: MTG, STG	21/22	-62, -34, -4	118
8	R-cerebellum		10, -86, -26	75
9	R-cerebellum		32, -84, -32	64
10	R-front: IFG	47	38, 18, -12	15
11	R-front: MFG, IFG	10	38, 48, 2	11
12	R-front/temp, STG, IFG	22/38/47	52, 18, -4	131
13	R-temp, ITG, MFG	20/21	58, -10, -20	57

(584) Cluster specification, main movement effect

L = Left, $\overline{R} = Right$; front = frontal lobe, temp = temporal lobe; IFG, MFG, and SFG = Inferior, Middle, and Superior Frontal Gyrus; ITG, MTG, and STG = Inferior, Middle, and Superior Temporal Gyrus; PrCG = Pre-Central Gyrus.

Comparing the two ways of representing the results, the glass brain in (583) and the table in (584), is become reasonable clear that the main movement effect is compatible with the outline of the distributed syntax network in section 4.8 above: **bilateral inferior frontal** (incl. Broca's area and bilateral BA47) (clusters #4, 10, and 12), **left posterior superior temporal** (Wernicke's area) (#7), **dorsal prefrontal** (#3), and **cerebellum** (#1, 2, 8, and 9). (There is also some activation outside the distributed network that constitutes the region of interest which is discarded from the analysis, including the bilateral Middle temporal activation).

What is most important from the present perspective is that there is increased activation in Broca's area (i.e. left BA44/45). It is interesting that BA47, located just below Broca's area, is activated bilaterally, while activation only extends into Broca's area in the left hemisphere (local activation maximum in the left cluster is also located in BA47), see (585) below.

This result is both expected and interesting as it shows that, as expected, Broca's area is crucially involved in syntactic movement and interesting because activation is not confined to Broca's area. However, the subtraction is still not constrained enough when one takes into account the fine-grained theoretical distinctions relevant to the linguistic stimuli. The '+Movement' condition comprises both *wh*-movement and NEG-shift, while the '-Movement' condition comprises both *wh*-movement and negative declaratives. In order to isolate what exactly contributes to the activation in Broca's area, such distinctions must be taken seriously. In other words, the question is what the interaction effect of target/type of movement on the location of activation is.



(585) Main movement effect: +Movement > -Movement (AC>BD)

The opposite subtraction (BD>AC), what is more active in the -Movement condition than in the +Movement condition, reveals no activation clusters at all at the corrected level (FDR, p<0.05), and at the uncorrected level only some clusters outside the regions of interest (except some bilateral cerebellar activation).

For completeness, before moving on to the movement × target interactions, I present the result of the random effect (RFX) analysis of the main movement effect. Given the prior anatomically constrained hypothesis about the activation pattern, it supports the FFX results above and shows that the results and conclusions drawn from them can be generalized to the general population of speakers, not only to the particular set of test subjects. There is only activation with uncorrected p-values (that may not be a problem with the experiment but rather with the nature of the RFX analysis itself, see section 5.1.3).

(586) Main movement effect (AC>BD) (RFX, uncorrected)



What is most striking at first is that there is much less activation in general and that the clusters are much smaller than was the case in the fixed effect analysis due to the constrained nature of the RFX analysis (see section 5.1.3 above). More interesting, there is only increased activation in the left hemisphere.

(587) Cluster specification, main movement effect (RFX, uncorrected)

#	Area	Brodmann area	Local max	Size
		(BA)	$(\mathbf{x}, \mathbf{y}, \mathbf{z})$	(voxels)
1	L-cerebellum: tonsil		-30, -46, -44	24
2	L-front: IFG	45/46	-54, 28, 12	14
3	L-sub-lobar: putamen		-28, -2, 8	14
4	L-temp: fusiform	37	-36, -52, -18	16
5	L-temp: STG, supramarginal	39 (range=3)	-48, -54, 22	12

L = Left; front = frontal lobe, temp = temporal lobe; IFG = Inferior Frontal Gyrus; STG = Superior Temporal Gyrus.

Note especially that there is increased activation in Broca's area, the supramarginal gyrus in the close vicinity to Wernicke's area, and in the cerebellum:

(588) Main movement effect (AC>BD) (RFX, uncorrected)



Left hemisphere

5.2.4 The CP-domain: *Wh*-movement

The first type of movement (the first half of the +Movement condition in the main effect) is wh-movement, which targets the leftmost edge of the CP-domain. The result of subtracting condition (D) (*yes/no*-questions) from condition (C) (*wh*-questions) resembles the main effect:

(589)

Target:	Operator movement	Operator insertion	
Spec-NegP	A: NEG-shift (<i>ingen</i>)	B: Neg Adv (<i>ikke</i>)	
(IP-domain)			
Spec-CP	C: Wh-question	D: Yes/no question	
(CP-domain)			

(The glass brain is given in (591) and the cluster specifications are given in the table in (592) below.)

The contrast reveals increased activation in **inferior frontal bilaterally** (incl. BA44 in Broca's area and bilateral BA45/47) (clusters #2, 16, and 17), **left posterior superior temporal** (incl. Wernicke's area and the supramarginal gyrus) (#10, 12, and 14), **dorsal prefrontal** (#4), and **cerebellum** (#1 and #15):

(590) *Wh*-questions > *yes/no*-questions (C>D)



(591) *Wh*-questions > *yes/no*-questions (C>D)







FFX (AC>BD), FDR p<0.05, Threshold = 10

#	Area	Brodmann area	Local max	Size
		(BA)	(x, y, z)	(voxels)
1	L-cerebellum		-28, -84, -30	12
2	L-front/temp: STG, PrCG, IFG, MFG	22/38/44/45/46/47	-50, 22, -10	828
3	L-front: IFG	46 (range=5)	-42, 16, 22	13
4	L-front: Interhemispheric, MFG	6/9	-2, 30, 40	20
5	L-front: MFG, SFG	10	-36, 56, 14	41
6	L-front: MFG, SFG	10	-32, 52, 0	40
7	L-front: PrCG, MFG	6/8/9	-42, 6, 48	69
8	L-front: SFG, MFG	6/8	-2, 24, 56	52
9	L-sub-lobar: putamen		-22, -2, 6	19
10	L-temp: ITG, MTG, STG	21/22	-66, -38, -2	364
11	L-temp: MTG	21	-54, 8, -26	16
12	L-temp: MTG, STG	21/22	-60, -20, -4	22
13	L-temp: parietal, MTG, angular	39	-46, -74, 28	21
14	L-temp: STG, supramarginal	22/39/40	-54, -56, 20	153
15	R-cerebellum/posterior/occipital		12, -88, -28	352
16	R-front/temp: STG, IFG	22/38/45/47	56, 20, -10	247
17	R-front: IFG, MFG	9/45/46	54, 18, 24	38
18	R-occipital	17/18	22, -96, -10	106
19	R-occipital	18	12, -88, -28	352

(592) Cluster specification, wh-movement

L = Left; front = frontal lobe, temp = temporal lobe, occipital = occipital lobe, posterior = posterior lobe; IFG, MFG, and SFG = Inferior, Middle, and Superior Frontal Gyrus; ITG, MTG, and STG = Inferior, Middle, and Superior Temporal Gyrus; PrCG = Pre-Central Gyrus.

It is interesting to note that the areas in cluster #14, the supramarginal gyrus (BA40) and the angular gyrus (BA39), are associated with *conduction aphasia* (word substitutions, naming problems, impaired repetition) and *anomia* (naming disorder), respectively, both of which are lexico-semantic deficits, not syntactic deficits. In both deficits comprehension as well as production is relatively intact (the problem lies in lexical retrieval), unlike Wernicke's aphasia where comprehension is impaired. There is no lexical difference between conditions (C) and (D) except for *hvilke* 'which' [Indef, Quant, Wh] (i.e. it's an indefinite quantifier and a question marker) in (C) versus *nogen* 'any' [Indef, Quant] in (D); in the latter condition, the [Wh] feature is inserted on the empty operator OP in spec-CP. It could be argued that that the activation in the posterior language regions reflects this difference in feature realization, or simply the overt lexical difference. However, if that were the case, the prediction would be that the same activation should result from the NEG-shift subtraction in the next section (with *ingen* 'no' [Neg, Indef, Quant] vs. *ikke* [Neg] + *nogen* [Indef, Quant], cf. chapter 2, section 2.4.3.2, (231)) which is not borne out.

Consider the cross-sections in (593) below:

(593) Cross-sections (C>D)



Though parts of BA45 in Broca's area are activated bilaterally (together with 47 in the left, i.e. lower part, and BA46 in the right, i.e. upper part), BA44 is only activated in the left hemisphere (cluster #2). That is, activation in Broca's region clearly shows left-lateralization, as is evident in (593) above; the cross marks the local (and in this case also the global) maximum in the left BA47. Also visible here are the activations in the dorsal prefrontal cortex, in Wernicke's region, and in the supramarginal gyrus.

The opposite contrast (D>C), what is more active in *yes/no*-questions than in *wh*questions, reveals no activation in the regions of interest, neither at the corrected level (FDR, p<0.05) nor at the uncorrected level.

In the random-effects analysis there is, as expected, much less activation but the RFX analysis (uncorrected) supports the result of the FFX analysis. Note, however, that except the activation in the cerebellum, there is only activation in the left side of the brain; in other words, cortical activation is left lateralized:

#	Area	Brodmann area	Local max	Size
		(BA)	(x, y, z)	(voxels)
1	L-front, IFG	45/46	-56, 26, 10	21
2	L-front, IFG	44/45	-60, 18, 18	29
3	L-front, IFG	47	-54, 28, -6	13
4	L-front, IFG (white)	47 (range=5)	-50, 30, -16	11
5	L-front, MFG	6	-40, 2, 48	20
6	L-temp, STG, supramarginal	22	-46, -54, 18	63
7	R-cerebellum, declive		14, -88, -28	10
8	R-cerebellum, uvula, tuber		24, -86, -38	11

(594) Cluster specification, *wh*-movement (RFX, uncorrected)

L = Left, R = Right; front = frontal lobe, temp = temporal lobe; IFG and MFG = Inferior and Middle Frontal Gyrus; STG = Superior Temporal Gyrus.





Crucially, the activation clusters are located in areas of the syntactic network: most importantly, in Broca's area and in the posterior part of the STG (Wernicke's area, including part of the supramarginal gyrus), as well as in the left BA47:

(596) *Wh*-questions > *yes/no*-questions (RFX, uncorrected)



Left hemisphere

5.2.5 The IP-domain: NEG-shift

The interaction effect of the target domain of syntactic movement becomes even more apparent when negative conditions are considered, namely clauses with NEG-shift versus clauses with a negative adverbial operator and the object in situ (A>B):

(597)

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)	J	
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)		

Unlike in the previous subtractions, **no voxels survive** the corrected threshold (FDR, p<0.05) when condition (B) is subtracted from condition (A).

At the **uncorrected** level (leaving irrelevant activation clusters aside), among the areas of the syntactic network there is only activation in the cerebellum and, notably, not in Broca's area. There is, however, activation in BA47 bilaterally, though the pattern is not symmetric (see (599) below): The left cluster (#2 in the table in (598) below) includes activation in BA38, which is the temporal pole, and BA13 (situated below BA47) where the local maximum is; the right cluster (#3) includes activation in BA11 (below to the front of BA47). Furthermore, the activation is clearly left-lateralized, see (600) below.

Bilateral BA47 was also found in result of the main movement effect (section 5.2.3) as well as in the *wh*-movement effect (section 5.2.4). The global maximum is in the middle temporal gyrus, in a cluster that includes activation in BA20/21/38. This cluster (#3) is also
reflected in the main movement effect (cf. #6 in the table in (584) above), as well as in the *wh*-movement effect (cf. #10, #11, and #12 in the table in (592) above).

This suggests that these areas play a role in syntactic movement, but further research is needed to see whether not there is a correlation between activation in these areas and syntactic phrasal movement. Furthermore, these areas lie outside the regions included in the anatomical constraints of the mapping hypothesis and therefore care should be taken not to draw conclusions from the uncorrected results.

(598) Cluster specification, NEG-shift (uncorrected)

#	Area	Brodmann area (BA)	Local max (x, y, z)	Size (voxels)
1	L-temp: ITG, MTG, STG	20/21/38	-60, -8, -20	273
2	L-front/temp: STG, IFG	13/38/47	-34, 12, -14	134
3	R-front: IFG, MFG	11/47	24, 28, -16	29

L = Left, R = Right; front = frontal lobe, temp = temporal lobe; IFG and MFG = Inferior and Middle Frontal Gyrus; ITG, MTG, and STG = Inferior, Middle, and Superior Temporal Gyrus.

(599) Cross-sections (A>B) (uncorrected)





Right hemisphere

Left hemisphere

The opposite contrast, that is NEG-adv (*ikke*) > NEG-shift (*ingen*) (B>A), revealed no activation in the areas of the network, neither corrected nor uncorrected.

To sum up, there is no increase in activation resulting from the NEG-shift > NEG-adv (A>B) subtraction, not even at the uncorrected level, in any of the areas of the syntactic network in (565) above, apart from some cerebellar activation at the uncorrected level. The main effect activations are therefore due to the movement in *wh*-questions alone.

5.2.6 The VP-domain: O-role Assignment

In the design there are no vP-specific movement operations that are present in one or more conditions but in others. However, instead of sorting the data according to the matrix in (572) above, it can be sorted according to whether the sentences are well-formed or anomalous across all the conditions; that is, the two subsets subtracted both cut across all four conditions:

(601)

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)		
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)	Ę	

Subtracting the anomalous sentences from the well-formed ones (well-formed > anomalous), thus asking what is more active in the well-formed sentences than in the anomalous ones, results in what we might call a semantic *well-formedness effect*.

What is different in the two conditions is that in the well-formed sentences, the main verb is able to assign θ -roles to both arguments in a straightforward way, whereas in the anomalous sentences, there is a mismatch between the θ -grid of the verb and one of the two

arguments; in other words, there is a violation of the selection restrictions of the verb, either by the subject or by the object. The result of this subtraction, then, is not a movement-related effect but has to do with semantic composition and θ -assignment.

At the corrected level (FDR, p<0.05) no voxels survive the subtraction. However, as shown in (602) below, there is an effect at the **uncorrected** level (p=0.001, threshold=20) in the hypothalamus and bilateral thalamus (mid-brain structures), bilateral anterior Middle/superior temporal gyrus, bilateral insula, and right inferior frontal gyrus IFG (BA6/9/13/44) (see the cluster specification in (603) below).

(602) Well-formed > Anomalous





FFX (well-formed>anom), Uncorrected p<0.001, Threshold = 20

(603) Cluster specification, Well-formed > Anomalous

#	Area	Brodmann area (BA)	Local max (x, y, z)	Size (voxels)
1	Hypothalamus		-6, -2, -10	105
2	L-insula	13	-40, 2, -6	66
3	L-temp: STG, insula	13, 22, 41	-46, -22, 4	38
4	L-thalamus		-22, -14, 10	84
5	R-front: PrCG, IFG, insula	6/9/13/44	50, 0, 14	85
6	R-temp: MTG, STG, insula	13/21/22	50, -14, 0	303
7	R-thalamus		12, -24, 8	61

L = Left, R = Right; front = frontal lobe, temp = temporal lobe; IFG = Inferior Frontal Gyrus; MTG and STG = Middle and Superior Temporal Gyrus; PrCG = Pre-Central Gyrus.

For the present purpose, what is most interesting is that there is increased activation in the **right** frontal region: RIFG and insula (and in the left insula) which is shown in the cross-sections in (604) below (the cross is in the right anterior superior temporal gyrus, cluster #6).



(604) Cross-sections (Well-formed > Anomalous)

There is no *anomaly effect* (anomalous > well-formed), not even at the liberal uncorrected level (except a single voxel, a so-called 'spike activation', in the occipital cortex, BA19). The 'repair' required in order to license the anomalous sentences pragmatically (as already mentioned, they are always true and syntactically well-formed) does not increase activation; only 'successful'/natural θ -integration, the semantic *well-formedness effect*, increases activation.

5.2.7 Main Effect: Force (AB vs. CD)

For completeness, I have also looked at the second main effect, the *force effect*, which is calculated by subtracting the declarative conditions, A and B, from the interrogative ones, C and D, or vice versa:

(605)

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)	Ļ	J
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)		•

Note that this is not a minimal contrast and conclusions should be made with caution. In all the examples the 'Declarative' condition (AB), there is movement of the subject to spec-CP in order to satisfy the V2 requirement; in addition in the NEG-shift examples (that is, half of the set) there is also movement of the object to spec-NegP⁸⁵. In the 'Interrogative' condition (CD), there is only movement to spec-CP in half of the examples, namely movement of the object to spec-CP in all the *wh*-questions (C); the phonetically empty question operator OP in *yes/no*-questions is presumably inserted directly in spec-CP (see chapter 2, section 2.3.11, footnote 29). (In the partial tree structures in (606) and (607) below, the dotted arrows indicate movement that only takes place in come of the examples while the unbroken arrow indicates movement that all the examples have.)

(606) Declarative (A, B)



⁸⁵ In all the examples except those with NEG-shift spec-NegP is filled by the adverb *ikke* 'not' which is moved from its base-position as adjoined to vP (cf. chapter 2, section 2.3.11). As both movement of the negative object and the negative adverb target spec-NegP in the IP-domain, there is no domain difference and no activation increase is predicted. Furthermore, movement to the IP-domain is not predicted to increase activation in Broca's area anyway under the Domain Hypothesis.



There is no effect (AB: Interrogative <> CD: Declarative Force) at the corrected level (FDR, p<0.05).

At the **uncorrected** level (threshold = 10 voxels), on the other hand, there is activation. In the Declarative > Interrogative (AB>CD) contrast, there is large activation cluster (#3 in (609), with the global activation maximum) in the frontal part of Broca's area (and insula). In all the declaratives (AB) there is movement to spec-CP (of the subject), while only half of the interrogatives (CD) have movement to spec-CP (of the object). There is thus more movement to the CP-domain in the declaratives than in the interrogatives which could explain the extra activation in Broca's area.

(608) Declarative > Interrogative (AB>CD) (uncorrected)



Left hemisphere

#	Area	Brodmann area (BA)	Local max	Size
			$(\mathbf{x}, \mathbf{y}, \mathbf{z})$	(voxels)
1	L/R-front/limbic: Ant.Cing.,	L-10/24/L-32/L-42	-4, 32, 8	209
	MFG, corpus callosum			
2	L-front/limbic: Ant.Cing.		-14, 18, -6	20
3	L-front: IFG, insula	45/46	-36, 34, 8	207
4	L-temp/occ/par: MTG,	19/39	-34, -76, 28	27
	SOG, angular gyrus			
5	R-front/limbic: Ant.Cing.,	32	14, 44, -14	120
	MFG, SFG, Medial FG			

(609) Cluster specification, Declarative > Interrogative

L = Left, R = Right; front = frontal lobe, temp = temporal lobe, limbic = limbic system, occ = occipital lobe, par = parietal lobe; IFG, MFG, and SFG = Inferior, Middle, and Superior Frontal Gyrus; Medial FG = Medial (inter-hemispheric) Frontal Gyrus; MTG = Middle Temporal Gyrus; Ant. Cing = Anterior Cingulate gyrus; SOG = Superior Occipital Gyrus.

There is also a lot of activation in the anterior cingulate gyrus (clusters #1, 2, 5):



(610) Cross sections (Declarative > Interrogative)

With the reverse subtraction, Interrogative > Declarative (as illustrated in (611) below), there is activation in BA45 in the right hemisphere, in the left BA6, and in the left junction

between the temporal lobe and the occipital lobe (including some activation in the angular gyrus / BA39) (see the cluster specifications in (612))).

(611)

Target:	Operator movement	Operator insertion
Spec-NegP	A: NEG-shift (ingen)	B: Neg Adv (<i>ikke</i>)
(IP-domain)	• •	
Spec-CP	C: Wh-question	D: Yes/no question
(CP-domain)		

Keeping in mind that it is not a minimal contrast, I propose that the (uncorrected) activation in RIFG may be a reflex of the merging of the interrogative operator OP in spec-CP. It is an event operator and may therefore activate the area which is also activated during computation of θ -structure and the VP-domain, namely, RIFG (see chapter 2, section 2.3.11, footnote 29).

(612) Cluster specification, Interrogative > Declarative

#	Area	Brodmann area (BA)	Local max (x, y, z)	Size (voxels)
1	L-occ/temp: MTG, STG	19/22/39	-58, -58, 8	131
2	R-front: IFG	45	62, 22, 14	19
3	L-front: MFG	6	-40, 4, 56	32

L = Left, R = Right; front = frontal lobe, temp = temporal lobe, occ = occipital lobe; IFG and MFG = Inferior and Middle Frontal Gyrus; MTG and STG = Middle and Superior Temporal Gyrus.

(613) Interrogative > Declarative (CD>AB) (uncorrected)



Right hemisphere

Left hemisphere

5.2.8 Summary

The main movement effect showed activation in both Broca's and Wernicke's areas. This effect was due to the effect of *wh*-movement, which also showed activation in the right BA45. NEG-shift did not contribute to the movement effect in these areas. This is compatible with

the Domain Hypothesis according to which movement targeting the CP-domain increases activation in Broca's area, whereas movement to IP does not. Contrasting the well-formed and the semantically anomalous sentences revealed an effect in the right BA44 and bilateral insula, which is also in accordance with the hypothesis which states that operations targeting the VP-domain activate the right frontal system. None of the reversed contrast yielded any activation in the regions of interest. This is also weakly collaborated by the uncorrected results from the contrasts between declarative and interrogative clauses. The declarative sentences increase activation in Broca's area which could be taken as a reflex of the movement of the subject to sentence-initial position, spec-CP. The interrogative sentences increased activation in the right BA45 which could be taken as a reflex of the merging of the question operator.⁸⁶

5.3 Other Neuroimaging Studies

In this section I review four syntactic neuroimaging studies, Ben-Shachar et al. (2003, 2004), Röder et al. (2002), and Fiebach et al. (2005), showing how the results of these studies fit the proposed *Domain Hypothesis*. In the latter two studies, I propose an alternative syntactic analysis of the linguistic stimuli which will make both stimuli and imaging results compatible with the Domain Hypothesis. Importantly, this also shows that results from experiments based on different linguistic frameworks can be made compatible as long as both results and linguistic input (and, optimally, also the specific analysis of the data underlying the test hypotheses) are included in the published material (cf. section 4.3 above).

In order to represent visually the activation patterns reported in the studies, I apply a stylized box representation of an axial view (i.e. from above) of the brain and mark activation with an asterisk (I use the term 'region' to include e.g. the vicinity of Wernicke's area such as the angular gyrus). The representation covers only (parts of) the cerebrum, not the cerebellum:

⁸⁶ Some further support comes from a previous fMRI study (see section 5.2.1 and footnote 84 above) that suffered from a number of methodological flaws: TR = event time and thus only one sampling point on the hemodynamic response function, too many conditions / parameters (8 parameters plus a dummy / 'base-line'), and too short scan time (10 minutes). The results did not reveal any significant activation, and at the uncorrected level there were only small widely scattered activations. However, when considering the *temporal derivative* in the results, an interesting result occurred. The temporal derivative may reveal activations based on response functions that have activation peaks one second before or one second later than the canonical response function (see Henson et al. 2002). The only cortical activation at the uncorrected level using the temporal derivatives that falls with the anatomical constraints (the 'language areas') consisted of a cluster (21 voxels) in the left pSTG (BA22) and a cluster (7 voxels) in the left IFG (in the white matter below the cortex within a range of 9 mm from BA45; admittedly this quite a distance away but BA45 is the closest area). However, the effect is a main effect that pools together both movements to both CP and IP (topicalization, NEG-shift, and object shift), so the contrast is far from minimal. I have not been able to establish which of the movement types contributed to the effect. Nonetheless, it is striking that the activation clusters are located in Wernicke's area and Broca's area, respectively, which is what the hypothesis predicts.

		Frontal			
	2	Fiolital			
Le	ft	Medial	Right		
IFG	ventral	Dorsal	ventral	IFG	
Broca's	precentral	prefrontal	precentral	BA44/45	
region	BA6	BA6/8	BA6	(and insula)	
BA44/45					
(and insula)					
		Anterior			
		cingulate			
		gyrus			
		BA24/32			
Heschl's					
complex					
BA41/42					
pSTG				pSTG	
Wernicke's				BA21/22	
region				39/40	
BA21/22					
39/40					
		Posterior			

(614) Stylized partial representation of the brain

For example, the result of Dogil et al.'s (2002) 'topicalization > re-serialization' contrast (see section 4.8 above) can be represented as follows:

(615) Dogil et al.'s (2002) topicalization > re-serialization



The effect of *wh*-movement found in my own the experiment is represented in (616):

(616) *Wh*-questions > *yes/no*-questions

*	*	*	*
*			
*			

Ben-Shachar et al. (2003) present an fMRI experiment on relative clauses in Hebrew. What they found was that when comparing object relatives, (617)a (leaving aside the trace in spec-*v*P), with embedded declaratives, (617)b, object relatives increased activation in Broca's area (Brodmann area BA 44/45 in the left inferior frontal gyrus, LIFG), but also bilaterally in the posterior superior temporal gyrus (pSTG, BA22/39), that is Wernicke's area and its right hemisphere homologue.

(617) a. (I helped the girl) [_{CP} OP₁ that [_{FinP} Mary saw t₁ in the park]] b. (I told Mary) [_{CP} that [_{FinP} the girl ran in the park]]

The effect is due to the movement of the object to spec-CP as all other parameters are kept constant. "The neural activity evoked by transformational analysis sets this process apart from other putative sources of computational complexity during sentence perception" (Ben-Shachar et al. 2003: 439).

(618) Object relatives > embedded declaratives



According to Ben-Shachar et al. (2003), "verb complexity" (= transitivity) activates LpSTG. They contrasted well-formed transitive examples, (619)a, with anomalous examples that differed only in having an intransitive verb instead of a transitive one and, hence, a 'superfluous' object, (619)b.

(619) a. (I helped the girl) that Mary saw in the parkb. *(I helped the girl) that Mary ran in the park

It seems to me that the result, rather than being an effect of verb complexity, is due to a *grammaticality effect*. Unlike the *well-formedness effect* in section 5.2.6 above, this effect is not the result of a subtraction of syntactically well-formed but semantically anomalous examples; rather, the difference relates to argument structure (the difference between

syntactically ungrammatical and semantically anomalous may be a mater of degree but that's a separate issue). The superfluous argument fails to get a θ -role altogether because the verb is intransitive and has already assigned its only θ -role to the subject. But this violation is not only related to θ -roles, it is also a structural violation as the verb does not select any complement at all.

Ben-Shachar et al. (2004) found that topicalization (in Hebrew) increased activation in Broca's area (BA44/45 in LIFG), left ventral precentral gyrus (L-vPrCG, BA6 bordering on BA9), and bilaterally in BA39 bordering on BA22/37 in the posterior superior temporal gyrus (pSTG), that is, in Wernicke's region, as well as in the primary auditory cortex, Heschl's complex BA41/42.

(620) Topicalization > Subject initial



When presenting their subjects with embedded *wh*-questions and *yes/no* questions, Be-Shachar et al. found that *wh*-movement increased activation in LIFG and, as with topicalization, L-vPrCG and bilateral pSTG.

(621) *Wh*-questions > *yes/no* questions



They did not find any significant difference between subject and object *wh*-questions which, at first sight, is surprising. As I have argued in the preceding chapters (see also section 4.6 above), the syntactic derivation proceeds in phases and the object has to move through spec-*v*P on its way to spec-CP. Thus, object questions (and object relatives) involve two movement steps for the object (from base to spec-*v*P to spec-CP) and one for the subject

(from base to spec-FinP), whereas subject questions involve only two movement steps, namely those of the subject, i.e. from the base-position in spec-*v*P to spec-FinP and from there to spec-CP. However, as both conditions crucially involve movement to spec-CP, no differential activation is predicted in Broca's area. Thus, it is in fact not surprising after all that there is no difference in activation between subject and object *wh*-questions.

So far, all contrasts have involved movement to the CP-domain and have shown activation in Broca's area (upper left corner in the representations). Ben-Shachar et al. (2004) also tested the so-called dative alternation or dative shift (DS): (622)a has the base-generated word order, while in (622)b the indirect object *the professor from Oxford* has shifted across the direct object *the red book*:

(622) a. John gave the red book to the professor from Oxfordb. John gave the professor from Oxford the red book

Theoretically, this alternation (whether the difference is due to movement or base-generation is a separate matter) is vP-internal; it does not involve movement to the higher domains. The contrast did not increase activation in Broca's area. However, activation was found in the right ventral precentral gyrus (R-vPrCG) and right anterior insula (R-aINS). This is compatible with the Domain Hypothesis stating that VP-internal operations crucially involves the right frontal system. "Interestingly, RaINS also showed a significant effect of linear order [...] with higher activations for the [O₂, O₁] order [i.e. indirect object - direct object order, K.R.C.], across topicalized and non-topicalized sentences. Thus, the DS effect found in this region may not be specifically related to dative shift, but could be a special case of the sensitivity to linear order in this region" (Ben-Shachar et al. 2003: 1328). However, linear order alone does not account for the *well-formedness* effect in section 5.2.6 or for the *semantic effect* in the next study.

Röder et al. (2002) investigated word order differences in German derived by the movement operation known as scrambling. The test sentences were different permutations of strings of words as exemplified in (623) resulting in four different structures as illustrated in (624)a-d (from Röder et al. 2002: 1005; the structural analysis is mine; the authors do not provide one).

(623) Jetzt wird der Astronaut dem Forscher den Mond beschreiben Now will the.NOM astronaut the.DAT scientist the.ACC moon describe Adv Aux Subj IO DO Verb (624) "Easy" / short scrambling:

a.	$[_{CP} Adv$	Aux _{fin}	[_{FinP}	Subj	[vP		IO	DO	Verb]]]
b.	[_{CP} Adv	Aux _{fin}	[_{FinP}	Subj	[vP]	DO	IO		Verb]]]

"Difficult" / long scrambling:

с.	$[_{\rm CP}$	Adv	$\texttt{Aux}_{\texttt{fin}}$		DO	IO	[_{FinP}	Subj	[vP	Verb]]]
d.	[_{CP}	Adv	$\operatorname{Aux}_{\text{fin}}$	IO	DO		[_{FinP}	Subj	[vP]	Verb]]]

As a control they used non-word sentences corresponding to the well-formed ones; they use the term "semantic" and "nonsemantic" sentences.

When they contrasted the sentences where both the indirect object (IO) and the direct object (DO) follow the subject (a and b) with those where IO and DO precede the subject, they found increased activation in LIFG (BA44/45), left middle and superior temporal gyrus pSTG (posterior BA21/22), left middle frontal gyrus (BA6), the left anterior cingulate gyrus (BA24/32), and the right insula.





Röder et al. (2002: 1011) conclude that "since other factors which affect sentence processing were held constant [...] and because we observed a modulation of inferior frontal cortex activity as a function of syntactic difficulty for both semantic and nonsemantic speech, our results are consistent with the proposal that the inferior frontal gyrus is essential for the "computation of grammatical transformations" [...] or more general, an online computation of the syntactic structure [...]." However, it seems to me that the crucial difference is not 'length' of movement (long vs. short) or 'difficulty' of type (neither of which are well-defined), but rather a matter of different target domains as predicted by the Domain Hypothesis. Assuming the subject to be in the same structural position (spec-FinP) in all the examples, the 'long' / 'difficult' examples have movement of the objects to a position above the subject, which marks the edge of the IP-domain. If, as I have argued, adjunction is limited to Merge (cf. chapter 2, section 2.3.7.1), the target cannot be a position adjoined to FinP; it

must be a specifier of a functional head in an articulated CP-domain. The 'short' / 'easy' examples involve movement inside vP, that is, in the VP-domain (or possibly also the IP-domain). The activation in (625), then, is the result of a scrambling-to-CP > scrambling-to-vP contrast.

Röder et al. (2002) also found activation in the right hemisphere homologue of Broca's are (R-BA44/45), but not as the result of a movement contrast. "Reliable right hemisphere activity was only obtained for lateral frontal cortex [RIFG, BA44/45, K.R.C.] in the across participants analysis for semantic vs. nonsemantic speech which is in agreement with the proposal that this region may be involved in the processing of semantic meaning as well (Shaywitz et al. 1995)" (Röder et al. 2002: 1011). What is crucially different between semantically well-formed sentences and non-word ("nonsemantic") sentences is that in the well-formed ones, there is θ -assignment which, by hypothesis, involves computation in the right frontal region; that is not the case for non-word sentences.

Fiebach et al. (2005) present results from an fMRI experiment on German scrambling in *wh*-questions as exemplified in (626) below (where a-d can be inserted in the underlined space), taking the distance (measured in number of words) between subject and object to be the relevant variable; (626)a is "short-object", i.e. the clause-initial *wh*-object is immediately followed by the subject, and (626)b is "long-object" because the adverbials intervene between the fronted *wh*-object and the subject. Likewise, (626)c is "short-subject", i.e. the subject is clause initial and immediately followed by the object, and (626)d is "long-subject" because the two adverbials intervene between the fronted *wh*-subject and the object.

(626)	Thomas	fragt	sich	 verständigt	hat
	Thomas	asks	SELF	called has	

a. "Short-object"

wenderDoktoramDienstag nachmittagnach dem Unfallwho.ACCthe.NOMdoctoronTuesdayafternoonafter the accident

b. "Long-object"

wenam Dienstag nachmittagnach dem UnfallderDoktorwho.ACC on Tuesdayafternoonafter the accident the.NOM doctor

c. "Short-subject"

werdenDoktoram Dienstag nachmittagnachdem Unfallwho.NOMthe.ACCdoctoronTuesdayafternoonafter the accident

d. "Long-subject"

weram Dienstag nachmittag nach dem Unfallden Doktorwho.NOM on Tuesdayafternoonafter the accident the.ACC doctor(Fiecbach et al. 2005: 82)

When comparing "long-object" and "short-object", Fiebach et al. (2005) found that the "long-object" *wh*-questions increased activation in BA44/45 (Broca's area) and BA21/22 (Wernicke's area, Middle STG) bilaterally. They did not find activation in any of these areas as the result of "long" vs. "short-subject".

(627) Long-object > short-object

*		*
*		*

Fiebach et al. (2005) does not provide the relevant syntactic analysis of the example sentences. I propose the (partial) analysis in (628)a-d below. Rather than attributing the observed activation differences to the "length" of the distance between subject and object, I suggest it is due to scrambling of the adverbials. Again I assume the subject to occupy spec-FinP. In the "short-object" condition ((628)a), the adverbials are adjoined to *v*P. In the "long-object" condition ((628)b), the adverbs scramble to a position above the IP-domain (arguably to specifiers of functional heads in the CP-domain), that is, higher than FinP, which is predicted by the Domain Hypothesis to increase activation in Broca's area.

```
(628) a. [<sub>CP</sub> wh-Obj [<sub>FinP</sub> Subj Adv Adv [<sub>vP</sub> Verb Aux<sub>fin</sub> ]]] (short-obj.)
b. [<sub>CP</sub> wh-Obj Adv Adv [<sub>FinP</sub> Subj [<sub>vP</sub> Verb Aux<sub>fin</sub> ]]] (long-obj.)
c. [<sub>CP</sub> wh-Subj [<sub>FinP</sub> t Obj Adv<sub>1</sub> Adv<sub>2</sub> [<sub>vP</sub> Verb Aux<sub>fin</sub> ]]] (short-subj.)
d. [<sub>CP</sub> wh-Subj [<sub>FinP</sub> t Adv<sub>1</sub> Adv<sub>2</sub> [<sub>vP</sub> Obj Verb Aux<sub>fin</sub> ]]] (long-subj.)
```

In the "short" vs. "long-subject" conditions ((628)c-d), the *wh*-subject is in spec-CP and there is no reason to assume that the object is scrambled higher than a position adjoined to vP (or to some projection in the IP-domain); the same goes for the adverbials. Apart from the *wh*-

subject, there is thus no additional movement to the CP-domain and by hypothesis there shouldn't be increased activation in Broca's area. The difference between "long" and "short-subject" does not (necessarily) include a difference in domain; both have movement to the edge of vP (or possibly into the IP-domain).

Wartenburger et al. (2004) could be taken to be a counter-example. They found that non-canonical > canonical word order did not result in activation in Broca's area (the effect was found in Wernicke's region (BA21/22/41/42) bilaterally). However, the linguistic conditions are internally too heterogeneous. In the non-canonical condition they conflate mono-clausal object wh-questions (movement to CP) and embedded object-to-subject raising (movement to embedded IP), as well as two ungrammatical types, namely, adjunct whextraction across an argument wh-element in the embedded CP (movement to matrix CP) and raising across an unlicensed expletive in the embedded clause (movement to matrix IP). In the canonical condition, they include embedded infinitives and embedded 'standard' transitives, as well as two ungrammatical types, i.e., personal pronoun used as an expletive (superfluous argument, θ -violation) and examples with case violations (accusative instead of dative). In my opinion, there are simply too many parameters that are not kept constant, and it is not clear what the result of their 'canonicity' effect actually shows. For the same reason, their 'grammaticality' effect (which conflates θ and case violations) is not conclusive (though wellformedness did not increase action in the right frontal region) and cannot be used as an argument for or against the Domain Hypothesis. Furthermore, the Domain Hypothesis does not predict increased activation in Broca's area as the result of 'canonicity' per se. Increased activation is predicted only when there is movement to the CP-domain in one condition but not in the other in a subtraction.

In summary, there is variation but, more importantly, also consistency; all the studies of movement targeting the CP-domain show activation in Broca's area, with or without activation in one or more of the other areas of the distributed syntax network (Ben-Shachar et al. 2003, 2004, Röder et al. 2002, Fiebach et al. 2005). Furthermore, absence of activation in Broca's area in movement contrasts can be attributed to the fact that the movements target other domains. Röder et al's (2002) semantic well-formedness condition relates to the VP-domain and showed activation in the right BA44/45; the vP-internal dative alternation in Ben-Shachar et al. (2004) activated the right frontal area in the vicinity of IFG (vPrCG and insula); the "short vs. long subject" contrast of Fiebach et al. (2005) targets either *v*P or IP and did not result in activation in the relevant areas. The lack of difference in activation between subject and object relatives (Ben-Shachar et al. 2004), can be attributed to the fact that both target spec-CP.

5.4 Working Memory (WM)

I have argued that syntactic domains must be taken into account when mapping syntax in the brain. Müller et al. (2003) argue that Broca's area houses working memory (WM) in general, i.e. non-domain-specific (monolithic) WM. The analyses of the data presented above show that such a position too simplistic and, I think, difficult to maintain. However, that does not mean that Broca's area does not play a role in WM. Clearly it does, but it is not general monolithic working memory. Though many researchers agree on this there is little consensus. Grodzinsky (2000*b*) proposes that Broca's area is recruited for 2-back tasks:

(629) We have identified a WM whose only role is keeping track of moved phrasal constituents. It plays a critical role in the processing of movement, but not other dependencies; and is makes contact with phrases, and excludes heads. Of the multiple memory systems required for sentence analysis in real-time, we seem to have isolated one which is located in LIFG, whose activity is manifest in 2- but not 1-back tasks in the intact brain. This is a generalized, yet restrictive characterization of a WM, possibly one of many such devices. Grodzinsky (2000b: 25-26)

Even though Grodzinsky's (2002*b*) proposal is very restricted, it does not cover the whole story. Bor et al. (2004) present data showing that bilateral BA45/47 (lower part of Broca's area) and posterior temporal BA21/22 (Wernicke's region) (among other areas) are activated in tasks that require WM for optimized encoding of structured chunks (e.g. number sequences with detectable periods), but not for unstructured information (no detectable periods). This is compatible with the role Broca's area plays in syntactic movement which also involves hierarchical structure.

According to Smith & Jonides (1999), the recruitment of the frontal areas is highly dependent on modality and/or the type of process in question:

(630) [There are] two major proposals about the organization of PFC [prefrontal cortex, K.R.C]. One is that PFC is organized by the modality of the information stored [...]. The second proposal is that PFC is organized by process, with ventrolateral regions (BA 45 and 47) mediating operations needed to sustain storage and dorsolateral regions (BA 46 and 9) implementing the active manipulation of information held in storage [...]. Our review provides support for both organizational principles. (Smith & Jonides 1999: 1659; emphasis added)

With respect to modality, verbal storage tasks (keeping linguistic material in memory) activate the left frontal region, including BA44, 45, 46, 9, and 6, spatial storage (remembering a spatial location) activates the right premotor cortex, and object storage (remembering an object) activates more ventral regions of the frontal lobe. Regarding processes, verbal tasks that require only storage (as in item recognition and rehearsal) lead primarily to activations in Broca's region that typically do not extend into the dorso-lateral prefrontal cortex (BA46/9), whereas verbal tasks that also require executive processes (such as *n*-back tasks) lead to activations that include DLPFC (cf. Smith & Jonides 1999: 1659). Generally, executive processes include attention and inhibition, task management, planning, monitoring, and, most relevant here, coding. Executive processes are crucially involved when processes are quite recent, and they have yet to lead to clear dissociations between processes. Perhaps the highest priority, then, is to turn further attention to executive processes and their implementation in frontal cortex" (Smith & Jonides 1999: 1660).

The following is an illustration of how linguistic processes and memory systems can be combined so that working memory WM analyses (see Caplan 2001, Carpenter et al. 2000, Hagoort et al. 1999, Smith & Geva 2000, Stromswold et al. 1996) and theoretical linguistics can be seen as compatible. (See also Gibson 1998 for an approach combining generative linguistics and working memory analysis).



(631) Memory

This approach places both Merge and Move in Broca's area (provided that Broca's area houses linguistic storage and executive WM processes), cf. also the research suggesting further subdivisions of function in Broca's area noted at the end of section 4.8 above. This is also compatible with the findings from aphasiology (see sections 4.5 and 4.7). In fact, this unification of WM and theoretical syntax also seems to call for a revival of the much vilified Derivational Theory of Complexity (DTC) in some form, as also suggested by Marantz (to appear). However, if the Domain Hypothesis is on the right track, there is no straight-forward relation between the complexity of syntactic computation and (i) neural implementation, which shows that target domains matter, not just number of operations, and (ii) response time which was shown not to reflect the differences between the four conditions in the experiment on NEG-shift and *wh*-movement, cf. section 5.2.2 above.

5.5 Summary and Conclusion: The Domain Hypothesis Revisited

Results from various brain and lesion studies, including the present one, show that the neural implementation (neurological organization) of syntactic processing is not uniform. Syntactic processing is implemented in a distributed cortical network reflecting interfacing between syntax and other cognitive systems. An analysis in terms of unanalyzed / general) WM is, at best, difficult to maintain: WM is not uniform either. Syntax relies on different types of WM: derivation by phase is a WM-saving way of computation, both on the phonological and the semantic side, as well as in the syntactic structure building itself. Hence, this is not an argument against WM per se.

I have presented data that supports the Domain Hypothesis stating that there is a target domain \times movement interaction, such that movement to the CP-domain crucially involves and increases activation in Broca's area, movement to the IP-domain does not require extra processing and therefore does not increase activation (compared to structures without movement), and VP-internal processes increase activation in the right frontal region. This is summarized in (632) (repeated from (567) above):





The results of the fMRI study in section 5.2 are summed up in the table in (633) below.

		IFG	pSTG	Dorsal PrFG	Cerebellum	BA47	Anterior Cingulate
a. Main movement	t (AC>BD)	Bilateral	Left	Left	Bilateral	Bilateral	_
b.	(BD>AC)	—	-	-	Bilateral ^u	-	-
c. Wh-movement	(C>D)	Bilateral	Left	Left	Bilateral	Bilateral	—
d.	(D>C)	_	_	-	-	_	—
e. NEG-shift	(A>B)	_	_	-	Left ^{<i>u</i>}	Bilateral ^u	—
f.	(B>A)	_	_	-	-	_	—
g. Well-formedness (Well>Anom)		Right ^u	_	-	-	_	—
h. Anomaly	(Anom>Well)	_	_	-	_	_	—
i. Declarative	(AB>CD)	Left ^{<i>u</i>}	_	-	-	_	Bilateral ^u
j. Interrogative	(CD>AB)	Right ^u	Left ^{<i>u</i>}	-	-	_	—

(633) Subtraction results

IFG = Inferior Frontal Gyrus, pSTG = posterior Superior Temporal Gyrus, PrFG = Pre-Frontal Gyrus; *u* = uncorrected.

What is clear from the results in the table is that NEG-shift does not contribute to the main movement effect in either Broca's or Wernicke's area (IFG and pSTG, respectively). Only *wh*-movement activates Broca's area. NEG-shift does, however, contribute to the main effect in BA47 bilaterally and in the cerebellum⁸⁷, though only at the liberal uncorrected level. (This indicates that BA47 may play a role in syntactic movement as well.) This is compatible with the Domain Hypothesis according to which movement to the CP-domain, but not movement to the IP-domain, increases activation in Broca's area.

The well-formedness effect shows activation in the right IFG (and bilateral insula). This is also compatible with the Domain Hypothesis stating that operations internal to the VP-domain activate the right IFG.

None of the reversed movement contrasts, or the reversed well-formedness effect (i.e. the anomaly effect) yielded any activation in the areas of interest. This supports the hypothesis that the observed effects are due to syntactic movement, the minimal contrast in the subtractions.

Considering the main force effects, the declarative>interrogative subtraction resulted in activation in the left IFG while the reverse contrast yielded activation in the right IFG (both at the uncorrected level and both non-minimal contrasts). The declarative effect in the left IFG may be taken to be due to the movement of the subject to spec-CP, and the interrogative effect in the right IFG may be taken to be a reflex of the merging of the phonologically silent question operator. Again, keeping the weaknesses of these two subtractions in mind, the results are compatible with the Domain Hypothesis.

⁸⁷ The cerebellum is not analyzed with regards to internal structure. Treating it as a monolithic module is, of course, a simplification and one that leaves unexplained why there is activation the cerebellum both in the main effect and in the opposite contrast.

The review of some other neuroimaging studies in section 5.3, showed that there is some variation in the results but, more importantly, there is clear consistency as well. In all the studies, movement to the CP-domain shows activation in Broca's area: topicalization (Ben-Shachar et al 2004, Dogil et al. 2002), *wh*-movement (Ben-Shachar et al. 2004), object relative clauses (Ben-Shachar et al. 2003), "long" scrambling (Fiebach et al. 2005, Röder et al. 2002).

The subtraction results that do not yield activation in Broca's area can be attributed to the fact that the movements target other domains. Röder et al.'s (2002) "semantic vs. nonsemantic" contrast shows activation in the right IFG. This is compatible with the hypothesis that processing of thematic information, which is vP internal, activates the right IFG. Likewise, the vP-internal dative alternation in Ben-Shachar et al. (2004) activated the right frontal area in the vicinity of IFG (vPrCG and insula). Fiebach et al.'s (2005) "long vs. short subject" subtraction does not show an effect. This may be due to the target of the scrambling which appears to be either the edge of vP or inside the IP-domain. The absence of difference between subject and object relatives in Ben-Shachar et al. (2004) may be attributed to the fact that in both subject relatives and object relatives the target of movement of the relative operator is spec-CP.

The fact that only *v*P- and CP-related movement shows an effect is in line with the theoretical conception of these two syntactic domains, but not the IP-domain, as strong phases (see chapter 1, section 1.2.5). Furthermore, not only does the *target* of movement matter: the *type* of movement is also important: it has to be phrasal (XP) movement, cf. that head (X°) movement is not affected in agrammatism (cf. Grodzinsky & Finkel 1998).

According to Platzack (2001*b*), agrammatic performance on movement phenomena related to the CP-domain is "hampered" but not inaccessible. For example, V2 and obligatory finiteness: finite verbs are correctly placed in V2 position, whereas non-finite errors are produced as root infinitives (see also Burchert et al., submitted); other examples are the obligatory subject in spec-FinP (which he takes to be a part of CP) and *wh*-movement. This holds at least for Swedish and German SLI children, children acquiring their L1, adults acquiring L2, and Broca's aphasics. The phenomena related to lower domains (such as verbobject order and particle-object order) are unaffected / target-like. "My conception of which phenomena belong to the C-domain is of course theory-/analysis-dependent and relies heavily on the argumentation in Branigan (1996) and Rizzi (1997)" (Platzack 2001*b*: 367, fn. 5). As Platzack states, "a natural conclusion is that the theoretical unification of the I-domain and the C-domain [...] might not correspond to the neurological organization" (Platzack 2001*b*: 375).

The IP- and VP-domains are more robust than the CP-domain in the sense that they are less vulnerable to brain damage in the language areas in left hemisphere than the CP-domain. In turn, IP is more vulnerable than VP as inflectional morphology is often affected in aphasia (cf. the *Pruning Hypothesis*, Friedmann 2003, Friedmann & Grodzinsky 1997, Grodzinsky 2000*a*).

The evidence seems to converge on the assumption that the CP, IP, and VP-domains are different, both syntactically and neurologically.

5.6 Empirical Predictions

The Domain Hypothesis makes a number of empirical predictions for further empirical research. However, it should be stressed that these predictions are not problems for or weaknesses of the Domain Hypothesis; they are natural further empirical questions of the sort that any falsifiable scientific research raises. These predictions have to do with operations targeting the IP- and VP-domains.

NEG-shift targets the IP-domain and comprehension of NEG-shift should be normal in Broca's aphasia, cf. that negation is generally rarely affected in agrammatism (e.g. Bastiaanse et al. 2002, Hagiwara 1995, Lonzi & Luzzatti 1993).

As **object shift** (see chapter 2, section 2.5) targets an IP-internal position, namely πP between FinP and NegP, it should also be unaffected in agrammatism and should not increase activation in Broca's area.

Passivization (and raising in general) is movement to the IP-domain and the prediction is that it does not increase activation. However, German and Dutch agrammatics perform normally on passives (in accordance with the hypothesis that movement to IP does not require extra computation in Broca's area), whereas the performance of English agrammatics is impaired, cf. Drai & Grodzinsky, in press. This suggests that the subject in English occupies a position in the CP-domain, contrary to what is standardly assumed, and that the correlation between passivization and Broca's area activation may be subject to language variation.

Furthermore, passivization involves a VP-internal change: the external argument is suppressed (optionally right-adjoined)) and the internal argument (the object) moves to the position normally associated with the subject, the inner spec-vP (there is thus also a change in θ -assignment). Therefore the right frontal region should be more activated.

Dative Shift should not be affected in agrammatism, but could potentially be impaired by lesions in the IFG in the right hemisphere.

Generally, θ -assignment should be affected by damage to the right IFG. As mentioned in section 4.5 above, the understanding of jokes and humour and of the event structure in

narratives are impaired after right hemisphere lesions and right hemidecortication. Whether or not processing of thematic information depends on a computational centre in the right IFG, that is whether or not focal brain damage in RIFG disrupts θ -assignment (in a broad sense) remains to be investigated. If so, it should manifest itself in impairments in **passivization** and **dative shift** as well as in the pragmatic domain.

There is also a question about **left-edge phenomena**. Assuming, as is standard at least in minimalist syntax, that there is a strong parallel between the structure (and interpretation) of clauses, i.e. CPs, and determiner phrases, DPs (see e.g. Haegeman & Guéron 1999: 411-446 for discussion). Arguably then, like CPs, DPs are also strong phases (cf. Chomsky 2001: 14, to appear: 9 and references cited there). The question is whether movement to the left edge of DP, that is, spec-DP, has the same or partly the neural activation pattern as movement to spec-CP. In other words, does movement to spec-DP increase activation in Broca's area? Furthermore, does DP internal movement map onto the cortical network in a fashion parallel to movement to IP and VP? In other words, does movement internal to the lexical core of NP (or rather, nP, parallel to vP) activate right hemisphere systems (parallel to the VP-domain)? And does movement that targets positions between nP and DP not increase activation (parallel to the IP-domain)?

As is evident, there is still much left for future research.

6 Conclusion

Movement takes place in the computational system C_{HL} , i.e. in the syntactic derivation, and therefore, it is subject to syntactic constraints on computation (Structure-dependency) and economy (see chapter 1). Thus, from a systemic point of view, XP-movement is syntactically motivated by and dependent on unvalued probes and EPP-features, i.e., probing heads with specifiers. From a functional point of view, as argued in chapter 2, movement may be triggered by the interfacing between syntax and other systems. For example, object shift (OS, cf. chapter 2, section 2.5) and right-dislocation (TH/EX, "heavy-XP shift", cf. chapter 2, section 2.3.7) are motivated by phonological/prosodic constraints – conditions on convergence at the articulatory-perceptual interface, Phonological Form (PF) (including the weigh principle and the Pronoun Criterion); NEG-shift (the movement of negative quantifiers to spec-NegP in order to license sentential negation), quantifier raising (QR), *wh*-movement, and topicalization are (functionally) motivated by information structure constraints – conditions on convergence at the conceptual-intentional interface, Logical Form (LF) (including the NEG-criterion, scope, and the Lexical Topic Constraint; cf. chapter 2, section 2.4, and chapter 3, section 3.2).

Internal to syntax, the derivation takes place in successive cyclic steps, and in turn, in successive chunks or phases, enforced by the constraints on computational economy. Conditions on phases and interfaces necessitate the licensing of multiple specifiers at phase edges as escape-hatches. Syntax provides the mechanisms for movement that may be motivated by non-syntactic conditions via interfacing with other cognitive systems.

NEG-shift is not merely a sub-case of other types of object movement, such as QR or OS. This is evident from the differences in the target positions and the varying violations of Holmberg's Generalization (HG) induced by the movements (cf. chapter 2, sections 2.3 to 2.4). For example, in Scan2 (i.e. some variants of colloquial Danish, Norwegian, and Swedish), all three types of movement, NEG-shift, QR, and OS, are subject to HG such that whenever a c-commanding verb or preposition intervenes between spec-NegP and the base-position of the object, movement is blocked. Non-negative objects simply fail to undergo OS and QR and remain in situ, whereas a repair strategy is applied to negative objects such that the feature bundle of negative indefinite quantification is realized, not as a single negative indefinite quantifier, such as the Danish *ingen* 'no', but as two different elements, namely, as a negative adverbial merged in spec-NegP, e.g. *ikke* 'not', and an indefinite quantifier in the object position, e.g. *nogen* 'any'. In Icelandic, only OS is subject to HG and both NEG-shift and QR (with some quantifiers) apply across verbs and prepositions.

In Danish, both OS and QR are subject to HG, while NEG-shift only respects it if a preposition intervenes in which case only *ikke...nogen* is possible (as in Scan2). OS targets a position above negation but below the subject, namely, spec- π P, while NEG-shift targets spec-NegP; QR targets the escape-hatch position, spec- ν P. Only NEG-shift and QR are operator movements and are allowed to apply covertly.

Though all three types of movement are subject to prosodic constraints, conditions that ensure convergence at PF, such as the weight principle, only pronominal OS seems to be motivated by such prosodic constraints alone (apart from the EPP-feature on the probing head), and not by information structure.

NEG-shift can not be reduced to negative movement per se either. NEG-shift is the movement of negative quantifiers to spec-NegP, primarily of objects but subjects (though arguably not in English) also undergo NEG-shift prior to movement to spec-FinP. This last movement step is arguably also negative movement because but definitely not NEG-shift. The same applies to topicalization of negative quantifiers. Furthermore, NEG-shift is operator movement and can take place covertly, which other types of negative movement can not. NEG-shift is thus also distinct from the movement of the negative adverbial operator, e.g. English *not*, from the position adjoined to vP to spec-NegP to license sentential negation (chapter 2, section 2.3.11), and if required, to spec-CP to be topic (chapter 3, section 3.2).

These syntactic micro-variations can be accounted for with an Optimality-theoretic framework assuming violable constraints on information structure, such as shape-conserving constraints on the licensing of objects under verbs (V-LICENSE) and propositions (P-LICENSE, no stranding), unambiguous encoding (the NEG-criterion), the Lexical Topic constraint; and syntactic constraints on pied-piping (no feature percolation, *PERC) and economy (cf. chapter 2, section 2.4, and chapter 3, section 3.2).

The idea of interface conditions also applies to the implementation of language in the brain (chapter 4 and 5). The Domain Hypothesis states that the interfacing between the derivational syntax and other cognitive systems is reflected in the brain as different activation patterns in a distributed network of computational sub-modules (see chapter 4, section 4.3). Interface conditions at the CP-domain require that elements that are related to the level of discourse/pragmatics, such as topic and illocutionary force, be in CP. Movement to the CP-domain, such as *wh*-movement, significantly and consistently increases activation in Broca's area, whereas operations applying inside the VP-domain, where semantic/thematic information is integrated (semantic well-formedness, θ -role assignment), increases activation in the right-homologue of Broca's area (see chapter 5, section 5.2).

These results are compatible with the hypothesis as well as with results of research on aphasia (and other types of language impairment) and the activation patterns found in other fMRI studies (chapter 4, sections 4.5, 4.7, and chapter 5, section 5.3). The different cortical fingerprints of the CP- and VP-domains are compatible the theoretical notion of phases; both the CP- and the VP-domain are strong phases (cf. chapter 1, section 1.2.5). Interestingly, the IP-domain is not considered to be a strong phase and my fMRI study on NEG-shift as well other fMRI studies on IP-related movement ('short' scrambling) do not show increased cortical activation in the distributed syntax network. At least, so far, the IP-domain escapes detection, both in terms of absence of neural activation and in terms of lack of empirical evidence in support for it being a strong phase.

What has hopefully become clear is that brain science and a formal approach to language such as the minimalist/biolinguistic one may benefit from each other.

Appendix

A. English Summary

Introduction

In Danish, as in many other languages, negation can be realized as a negative adverbial or as a negative indefinite quantified object. In many languages both types of negative marker must be in the middle of the clause and. As this is not the canonical object position, I argue that the object moves to the position of negation, i.e. undergoes *NEG-shift* (NS).

The aim of the study is two-fold. **Part I** is a study in *theoretical and comparative linguistics* involving a wide range of languages, incl. the Scandinavian languages, English, Hebrew, Portuguese, Finnish, Polish, German, and Dutch. The goal is to provide an analysis based on universal principles that accounts for the variations in the movement phenomena and the constraints they are subject to, incl. syntactic constraints on computation and economy and constraints on information structure. At the heart of the analyses are the concepts of *phases* and *interfaces*.

Part II is a *neurolinguistic* study. Based on studies on aphasia, syntactic processing has been argued to be localized in the left frontal lobe. I present results from a neuroimaging study on movement and argue that syntax is implemented in a distributed bilateral network. The hypothesis, which is based on the syntactic analysis of NS, is supported by the results from other neuroimaging studies. Again, *interfaces* play a central role and I argue that the interfacing between syntax and cognition also has a neural reflex.

Overview

Preliminaries

I first outline the minimalist derivational approach to syntax with its explicit constraints on *structure-dependency* and *computational economy*. At three stages of the derivation, syntax maps onto the cognitive conceptual-intentional system, namely, I argue, at the completion of the VP-, IP-, and CP-domains. The two systems are compatible but *discontinuous*. The path from the level of the brain through the level of syntax (language) to the level of information structure (mind) is not linear, which is parallel to other systems in physics, such as the *phase-transitions* from liquid to crystal or gas. There is also a parallel between movement and abstract traces in syntax and abstract elements assumed in the sciences to account for a wide

range of phenomena from mathematical constants through quarks and molecules to planets and black holes.

PART 1: Syntax & Negation

NS takes place in order to license sentential negation:

(1) Jeg har <u>ikke</u> fået <u>nogen gaver</u>
 I have not gotten any presents
 (2) Jeg har <u>ingen gaver</u> fået
 I have no presents gotten

I argue that *ingen* is not the result of a post-syntactic merger of *ikke* and *nogen*, as only *ingen* can be the subject or a sentence-initial or sentence-medial object preceding the main verb.

A comparison of three Danish corpora shows that NS is much more frequent in written than in spoken language but also that NS is in fact not only found in formal speech or written text.

I argue that different types of object movement target different specifier positions. Quantifier raising (QR) targets the outer spec-vP where it enters into long-distance agreement with the probing feature, [uQuant]. By comparing the syntactic distribution of quantifiers in general and differences in scope of negative quantifiers in particular, I propose a revision to the conditions on covert movement such that only operator movement (NS, QR, and whmovement) may occur covertly by stranding the phonological features. The same mechanism underlies right-dislocation of phonologically heavy phrases.

In the history of English, OV was lost gradually. First, the option of VP-internal OV is lost at the end of the Old English period. In Middle English, overt QR disappears; at some later point, NS is also lost, resulting in Modern English having rigid VO order (disregarding *wh*-movement). In the history of Danish, its ancestor, Old Norse, has general OV word order, but OV gradually disappears in later stages. Early Modern Danish allows QR, while the only case of OV retained in Modern Danish is NS.

Because the checking of unvalued features on probes requires that the probe ccommands the goal, I argue that negative adverbials are merged as adjuncts of vP and attracted to spec-NegP by the probing Neg^o to check EPP.

Whether NS applies overtly or covertly is subject to parametric variation. I propose a revision to the *NEG-criterion* such that it is an information structure constraint requiring that

negation be maximally overtly marked. The NEG-criterion potentially conflicts with syntactic constraints on, e.g., *Structure Preservation*. When the negative object is the complement of a non-finite verb, the languages in the analysis fall into three groups. In group 1 (Icelandic, Faroese, Danish, Norwegian, Swedish, and, arguably, Dutch and German), NS applies obligatorily across the verb (violating *Holmberg's Generalization*). In group 2 (some variants of colloquial Danish, Norwegian, and Swedish), the optionality of the choice between *ingen* and *ikke nogen* is *neutralized*, and only *ikke nogen* is possible. In group 3 (Finland Swedish, English, and French, except with French *rien* 'nothing'), the negative object remains in situ (NS applies covertly). When the selecting head is a preposition, group 2 and 3 pattern as before (neutralization in group 2 and object in situ in group 3), while group 1 is divided into three subgroups: group 1.a has *preposition stranding*, group 1.b has *pied-piping*, and group 1.c. has *neutralization*. Further complications arise with double objects where the constraints on object shift and NS and on structure preservation are in conflict with each other.

There is no doubt that *ingen* is an XP given, e.g., that it can be a subject or an object, and that it can be topicalized. When *ingen* moves, it targets specifiers. With the negative adverbial operator, e.g. *ikke*, things are more complicated. I argue that it is an XP even though it cannot be topicalized in Danish and English. The difference between Danish and English on one hand and the rest of the Scandinavian languages on the other is that the requirement that the element in spec-CP be lexical, the *Lexical Topic Constraint*, has a higher priority in Danish and English than in the other languages.

In earlier stages of both Danish and English, negation could be sentence-initial. I present analyses of the diachronic changes from the proto-languages to the modern versions of Danish and Modern English using only three violable information structure constraints on topicalization and scope. I argue that the licensing of NEG-topicalization and Jespersen's Cycle (categorical oscillation) has little, if anything, to do with each other, except that XP status is a necessary prerequisite for topicalization.

Word order variation is also found with negation and infinitives. I argue that in the split infinitive, the infinitive marker undergoes movement. It is t is merged as v_{INF}^{o} , the topmost head in the VP-domain. In Faroese, the infinitive marker does not move and the infinitive marker always immediately precedes the verb; in Danish, it optionally moves one step allowing only VP-adverbials to split the infinitive, while in English and Norwegian, there are two optional movement steps, as it may either precede both sentential negation and VP-adverbials, intervene between them or remain in situ and thus follow both. In Swedish and Icelandic, the infinitive marker obligatorily moves to Fin^o and precedes all adverbials; in

Icelandic, it is an incorporating head that attracts the infinitive verb before movement to Fin^o as a complex head.

Furthermore, I argue that the movement of the infinitive marker (including its parameterized presence or absence in ECM and raising) may be motivated by feature checking. In all the Scandinavian languages and English, PRO checks the EPP-feature on Fin^o, but only in Danish, English, and Norwegian does it also check φ -features on Fin^o. In these three languages, movement of the infinitive marker is optional and presumably motivated by scope. However, in Icelandic and Swedish, I argue, the infinitive marker, not PRO, checks the φ -features on Fin^o, which is why movement from v_{INF}^{o} to Fin^o is obligatory; PRO only checks EPP. In Faroese the infinitive marker never moves. This can be accounted for by assuming that, as in Icelandic and Swedish, PRO only checks EPP and that *at* checks φ -features, but that in Faroese these φ -features are weak and do not attract *at*, whereas they are strong (and attracting) in Icelandic and Swedish.

PART 2: Syntactic Movement and the Brain

I outline the *biolinguistic approach* to language and how it is implemented in the human biology. This approach has a very narrowly and explicitly defined object of inquiry, namely, the computational system C_{HL} . This approach offers a sufficiently elaborate system of well-defined distinctions and computational operations, whereas neurolinguistic studies often underestimate the complexity of language and operate with notions such as perception and production. Furthermore, the biolinguistic view of the core system of language operates with computational processes which are compatible, at least in principle, with the functioning of the brain.

Language is a cognitive *module*; a designated / specialized subcomponent of the mind. However, the fact that it is a module at the cognitive level does not mean that it has to be a single, localized module at the level of the brain. Rather, I argue, language (narrowly defined) is implemented in the brain as a distributed network of sub-components or computational centres.

Some linguistic functions seem to be *lateralized*, such that they depend more heavily on either the right of the left hemisphere. Based on the findings in lesion studies, it appears that phonology/phonetics, lexical semantics, and the syntactic operations Merge and Move are left-lateralized, while prosody, some aspects of pragmatics, and thematics are right-lateralized.

Interface conditions are a recurrent theme throughout the dissertation, and they also plays a crucial role in the analysis of the implementation of language in the brain. According

to the *Domain Hypothesis*, differential activation in the distributed network is due to interfacing between the syntactic derivation and these subsystems. Specifically, the CP-domain activates Broca's area in the left hemisphere, and the VP-domain activates the right homologue; the IP-domain, however, does not appear to have it own distinctive cortical fingerprint.

I present the results from an fMRI study of operator movement in Danish, specifically, NS and *wh*-movement. The behavioural results show that there is no difference in correct performance or in response time, which shows that there is no difference in task difficulty that the cortical activations can be attributed to. *Wh*-movement increases activation in Broca's area (and Wernicke's area), while NS does not activate any of the areas in the distributed network. The result of contrasting the well-formed sentences with the semantically anomalous sentences is an increased activation in the right-homologue of Broca's area. This well-formedness effect, I argue, reflects the difference in θ -role assignment which is a VP-internal operation.

The activation results support the Domain Hypothesis. A review of some other fMRI studies shows that the results of these studies, though the linguistic hypotheses in some of them are formulated within other theoretical frameworks, are compatible with the Domain Hypothesis. Movement to CP (topicalization, *wh*-questions, and 'long' scrambling) increases activation in Broca's area; movement to IP (NS and 'short' scrambling) does not show a cortical reflex; operations internal to the VP-domain (the dative alternation and θ -role assignment) increase activation in the right homologue of Broca's area.

What should also be clear is that brain science and formal linguistic theory can benefit from each other.

B. Dansk Resume

Introduktion

I dansk, ligesom i mange andre sprog, kan sætningsnegation udtrykkes med et negativt adverbial eller med et negativt ubestemt kvantificeret objekt. I en lang række sprog skal begge stå midt i sætningen for at udløse sætningsnegation. Eftersom det ikke er den normale objektsplads, argumenterer jeg for at objektet undergår flytning, en flytning jeg kalder *NEG-shift* (NS).

Undersøgelsen har to mål. **Del I** er et studie i teoretisk og komparativ lingvistik der involverer en række af sprog, inkl. de skandinaviske sprog, engelsk, hebraisk, portugisisk, finsk, polsk, tysk og hollandsk. Målet er en analyse baseret på universelle principper der kan redegøre for variationen i de syntaktiske flytninger og de betingelser der regulerer dem, inkl. kriterier for abstrakt beregning og økonomi. I hjertet af analyserne ligger ideen om grænseflader og om at den syntaktiske struktur opbygges i faser.

Del II er et neurolingvistisk studie. Baseret på undersøgelser af afasi i en lang række sprog er der blevet argumenteret for at syntaktisk forarbejdning er lokaliseret i et bestemt område i den venstre hjernehalvdel. Jeg fremlægger resultater fra en hjerneskanningsundersøgelse af NS og *hv*-flytning og opstiller hypotesen om at syntaktisk forarbejdning er implementeret i hjernen i form at et distribueret netværk der involverer begge hjernehalvdel.

Grænseflader spiller også her en central rolle, og jeg argumenterer for at kommunikationen ved disse grænseflader også er reflekteret i hjernens.

Synopsis

Forudsætninger

Jeg giver først en introduktion til den minimalistiske tilgang til syntaks med dens eksplicitte betingelser for strukturafhængighed og økonomi. På tre stadier i den syntaktiske derivation, ved fuldførelsen af VP-, IP- og CP-domænet, er der kommunikation mellem syntaksen og det kognitive konceptuelle/intentionelle system. De to systemer er kompatible men diskontinuerte. Vejen fra det neurale plan (hjernen) over syntaksen (sprog) til informationsstruktur (kognition) er ikke lineær hvilket er parallelt til andre systemer i fysikkens verden som fx i faseovergangene fra væske til krystal eller gas. Der er også en parallel mellem flytning og abstrakte spor i syntaksen og de abstrakte elementer der antages i videnskaben for at redegøre for en bred vifte af fænomener fra matematiske konstanter over kvarker og molekyler til planeter og sorte huller.

DEL 1: Syntaks & Negation

NEG-shift (NS) finder sted for at udløse sætningsnegation:

(1) Jeg har <u>ikke</u> fået <u>nogen gaver</u>
 I have not gotten any presents
 (2) Jeg har <u>ingen gaver</u> fået
 I have no presents gotten

Jeg argumenterer for at *ingen* ikke er en post-syntaktisk sammensmeltning af *ikke* og *nogen*, eftersom kun *ingen* kan være subjekt, et fremflyttet objekt i førsteposition eller objekt midt i sætningen før hovedverbet.

En sammenligning af tre danske korpusser viser at NS er hyppigere i skriftsproget end i talesproget, men også at det ikke kun findes i formel tale eller skrevet tekst.

Jeg argumenter for at forskellige typer objektflytninger flytter objektet til forskellige specifikatorpositioner. Kvantorløft (QR) er flytning til den ydre spec-vP hvor det kongruerer med sonden [uQuant]. På baggrund af en sammenligning af den syntaktiske distribution af kvantorer i almindelighed og negative kvantorer i særdeleshed foreslår jeg en ændring af betingelserne for skjult flytning således at det kun er operatorflytning (NS, QR, og *hv*-flytning) der kan flytte skjult ved at efterlade de fonologiske træk. Den samme mekanisme anvendes ved flytning til ekstraposition.

I det engelske sprogs historie sker tabet af Objekt-Verbum-ordstillingen (OV) gradvist. Først forsvinder muligheden VP-intern OV, og i middelengelsk forsvinder QR. Senere går NS også tabt hvilket resulterer i at moderne engelsk har fast VO (undtagen i *hv*-spørgsmål). Oldnordisk har generel OV, men OV forsvinder gradvist i de senere stadier. Ældre nydansk tillader QR, mens det eneste tilfælde af OV i moderne dansk er NS.

Da c-kommando er påkrævet ved legitimering eller tjek af træk, foreslår jeg at negative adverbialer indsættes i strukturen som adjunkter til *v*P, og at de derefter tiltrækkes af Neg^o til spec-NegP for at tjekke EPP.

Om NS finder sted synligt eller skjult er underlagt parametrisk variation. Jeg foreslår en ændring af NEG-kriteriet, således at det er en regel for informationsstruktur der kræver at negationen er maksimalt udtrykt. NEG-kriteriet er i potentiel konflikt med syntaktiske betingelser for fx strukturbevarelse. Når det negative objekt er komplement til et nonfinit verbum kan sprogene i min analyse inddeles i tre grupper. I gruppe 1 (dansk, færøsk, islandsk, norsk, svensk, og sandsynligvis hollandsk og tysk), flytter NS henover verbet (og overtræder
Holmbergs Generalisering). I gruppe 2 (nogle varianter af dansk, norsk og svensk talesprog) neutraliseres valgfriheden mellem *ingen* og *ikke nogen* og kun sidstnævnte er mulig. I gruppe 3 (engelsk, finlandssvensk og fransk, undtagen fransk *rien* 'ingenting') bliver objektet stående (og NS er skjult). Når objektet er styrelse for en præposition, er mønstret for gruppe 2 og 3 uændret (neutralisering i gruppe 2 og objekt *in situ* i gruppe 3), mens gruppe 1 deler sig i tre undergrupper. Gruppe 1.a har præpositionsstranding, gruppe 1.b har "rottefænger-konstruktion" og gruppe 1.c har neutralisering. I dobbeltobjektkonstruktionen opstår der yderligere komplikationer da betingelserne for *object shift*, NS og strukturbevarelse er i gensidig konflikt.

Ingen er utvivlsomt en XP eftersom det kan være subjekt eller objekt, og det kan være topik. *Ingen* flytter altså til en specifikator når det flytter. Med den negative adverbielle operator *ikke* er det mere kompliceret. Selvom den ikke kan topikaliseres i dansk eller engelsk, argumenterer jeg for at den er en XP. Forskellen mellem dansk og engelsk på den ene side og resten af de skandinaviske sprog på den anden er at kravet om at spec-CP skal have leksikalsk indhold har højere prioritet i dansk og engelsk end i de andre sprog.

I tidligere stadier af både engelsk og dansk kan negationen stå først i sætningen. Jeg præsenterer en analyse af de historiske ændringer fra proto-sprogene til de moderne versioner af dansk og engelsk vha. kun tre betingelser eller regler der kan overtrædes – informationsstrukturelle betingelser for topikalisering og skopus. Jeg argumenter for at betingelserne for NEG-topikalisering og Jespersens cyklus (kategorioscillation) har meget lidt (om noget overhovedet) med hinanden at gøre udover at XP-status er en nødvendig forudsætning for topikalisering.

Ordstillingsvariation findes også i infinitiver med negation, og jeg argumenterer for at infinitivsmarkøren *at* flytter i "delte" infinitiver. Infinitivsmarkøren indsættes som v_{INF}^{o} , den øverste kerne i VP-domænet. I færøsk flytter den ikke og står således altid umiddelbart før verbet. I dansk flytter den valgfrit et trin og tillader således at VP-adverbialer enten deler eller ikke deler infinitiven. I engelsk og norsk er der to valgfrie trin, eftersom infinitivsmarkøren enten kan stå før både sætnings- og VP-adverbialer, mellem dem eller efter begge umiddelbart før verbet. I svensk og islandsk flytter infinitivsmarkøren obligatorisk til Fin^o og kommer før alle adverbialer. I islandsk er den en inkorporerende kerne der tiltrækker verbet før de sammen flytter til Fin^o som en kompleks kerne.

Jeg argumenterer ydermere for at flytningen af infinitivsmarkøren (inkl. om den tillades i ECM-konstruktioner og i subjektsløft) kan motiveres af tjek af træk. I alle de skandinaviske sprog og engelsk tjekker PRO EPP-trækket på Fin^o, men det er kun i dansk, engelsk, og norsk at PRO også tjekker φ-trækkene på Fin^o. I disse tre sprog er flytningen af infinitivsmarkøren valgfri og antageligvis styret af skopus. I islandsk og svensk er det infinitivsmarkøren og ikke PRO der tjekker φ -trækkene på Fin^o, og derfor er flytningen fra v_{FIN}^{o} til Fin^o obligatorisk; PRO tjekker kun EPP. I færøsk flytter infinitivsmarkøren aldrig. Det kan der redegøres for ved at antage at PRO kun tjekker EPP, ligesom i islandsk og svensk, men at φ -trækkene i færøsk er svage og derfor ikke tiltrækker *at*, hvorimod de er stærke i islandsk og svensk og derfor tiltrækker infinitivmarkøren.

DEL 2: Syntaktisk Flytning og Hjernen

Jeg giver først et kort overblik over den biolingvistiske tilgang til sprog og dennes syn på hvordan sproget er implementeret i menneskets biologi. Denne tilgang tager som sit objekt det meget snævert og eksplicit definerede beregningssystem C_{HL} og tilbyder et tilpas detaljeret system af veldefinerede distinktioner og operationer, hvorimod neurolingvistiske studier ofte undervurderer sprogets kompleksitet og opererer med begreber som sprogproduktion og - perception. Ydermere opererer den biolingvistiske tilgang med beregningsprocesser der, i hvert fald principielt, er kompatible med måden hjernen arbejder på.

Sprogsystemet er et kognitivt modul – en specialiseret komponent i vores kognitive system. Men det at det er et modul på det kognitive plan, betyder ikke nødvendigvis at det svarer til et enkelt lokaliseret modul i hjernen. Jeg argumenterer for at det snarere er implementeret i hjernen som et distribueret netværk af undermoduler eller beregningscentre.

Nogle sproglige funktioner synes at være placeret unilateralt således at de afhænger mere af den ene side af hjernen end af den anden. Ud fra undersøgelser af hjerneskader ser det ud til at fonologi/fonetik, leksikalsk semantik og de syntaktiske operationer Forbind og Flyt ligger i venstre side, mens prosodi, visse pragmatiske aspekter og tilskrivningen af tematiske roller ligger i højre side.

Grænseflader er et tilbagevendende tema i afhandlingen, og de spiller også en vigtig rolle i analysen af implementeringen af sprog i hjernen. Ifølge Domænehypotesen, som jeg opstiller, skyldes forskellige aktiveringsmønstre i det distribuerede netværk udveksling ved grænsefladerne mellem den syntaktiske derivation og disse undersystemer. Mere specifikt aktiverer CP-domænet Brocas område i venstre hemisfære, mens VP-domænet aktiverer den højre homolog. IP-domænet derimod, ser ikke ud til at have sit eget distinktive kortikale fingeraftryk.

Jeg fremlægger resultaterne af en fMRI-undersøgelse af operatorflytning i dansk, nærmere betegnet NS og *hv*-flytning. Adfærdsresultaterne viser at der ikke er nogen forskel i korrekt besvarelse eller i reaktionstid hvilket viser at der ikke er nogen forskel i sværhedsgrad som hjerneaktiviteterne kan tilskrives. *Hv*-flytning øger aktiviteten i Brocas område (og i Wernickes område), hvorimod NS ikke aktiverer noget område i det distribuerede netværk. Resultatet af kontrasten mellem velformede og semantisk anomale sætninger viser øget aktivitet i den højre homolog til Brocas område. Denne velformethedseffekt argumenterer jeg for reflekterer forskellen i tilskrivningen af θ -roller – en VP-intern proces.

Resultaterne understøtter således Domænehypotesen. En gennemgang af andre fMRIundersøgelser viser at deres resultater også er kompatible med hypotesen, selvom de lingvistiske hypoteser i nogle af dem er formuleret indenfor andre teoretiske tilgange.

Flytning til CP (topikalisering, *hv*-flytning og "lang" *scrambling*) øger aktiviteten i Brocas område. Flytning til IP (NS og "kort" *scrambling*) viser ikke en neural effekt. Operationer internt til VP-domænet (dativalternation og θ -rolletilskrivning) øger aktiviteten i den højre homolog til Brocas område.

Hvad der også gerne skulle være klart er at hjerneforskningen og formel lingvistisk teori kan have udbytte af hinanden.

C. Linguistic Input

Condition A: Subj Aux Adv ingen ('no') NP Verb

- (1) Kirurgen har vist ingen bøger læst. Surgeon-the has 'I-guess' no books read
- (2) Lægen har vist ingen prøver taget. Doctor-the has 'I-guess' no tests taken
- (3) Manden har vist ingen lyde hørt. Man-the has 'I-guess' no sounds heard
- (4) Konen har vist ingen sko haft. Wide-the has 'I-guess' no shoes had
- (5) Eksperten har vist ingen fejl lavet. Expert-the has 'I-guess' no mistakes made
- (6) Konen har vist ingen penge fået. Wide-the has 'I-guess' no money received
- (7) Manden har vist ingen gaver haft. Man-the has 'I-guess' no presents had
- (8) Lægen har vist ingen lyde hørt. Doctor-the has 'I-guess' no sounds heard
- (9) Æsken har vist ingen hjørner haft. Box-the has 'I-guess' no corners had
- (10) Tøjet har vist ingen farver haft. Clothes-the have 'I-guess' no colours had
- (11) Maskinen har vist ingen lyde lavet. Machine-the has 'I-guess' no sounds made
- (12) Bordet har vist ingen hjørner haft. Table-the has 'I-guess' no corners had
- (13) Katten har vist ingen fisk spist. Cat-the has 'I-guess' no fish eaten
- (14) Fuglen har vist ingen korn fundet. Bird-the has 'I-guess' no seeds found
- (15) Manden har vist ingen fisk fanget. Man-the has 'I-guess' no fish caught
- (16) Konen har vist ingen ideer fået. Wife-the has 'I-guess' no ideas gotten
- (17) Manden har vist ingen mål taget. Man-the has 'I-guess' no measures taken
- (18) Konen har vist ingen frugter fundet. Wife-the has 'I-guess' no fruit found

- (19) Eksperten har vist ingen huse købt. Expert-the has 'I-guess' no houses bought
- (20) Katten har vist ingen lyde hørt. Cat-the has 'I-guess' no sounds heard
- (21) Kirurgen har vist ingen chancer taget. Surgeon-the has 'I-guess' no chances taken
- (22) Lægen har vist ingen fejl fundet. Doctor-the has 'I-guess' no errors found
- (23) Manden har vist ingen venner haft. Man-the has 'I-guess' no friends had
- (24) Konen har vist ingen kasser fundet. Wife-has 'I-guess' no boxes found
- (25) Eksperten har vist ingen prøver taget. Expert-the has 'I-guess' no tests taken
- (26) Konen har vist ingen huse købt. Wife-the has 'I-guess' no houses bought
- (27) Manden har vist ingen penge fået. Man-the has 'I-guess' no money received
- (28) Lægen har vist ingen bøger fundet. Doctor-the has 'I-guess' no books found
- (29) Æsken har vist ingen farver haft. Box-the has 'I-guess' no colours had
- (30) Tøjet har vist ingen fejl haft. Clothes-the have 'I-guess' no flaws had
- (31) Maskinen har vist ingen fejl lavet. Machine-the has 'I-guess' no error made
- (32) Bordet har vist ingen farver haft. Table-the has 'I-guess' no colours had
- (33) Katten har vist ingen lyde lavet. Cat-the has 'I-guess' no sounds made
- (34) Fuglen har vist ingen frugter spist. Bird-the has 'I-guess' no fruit eaten
- (35) Manden har vist ingen bøger købt. Man-the has 'I-guess' no books bought

- (36) Konen har vist ingen farver set. Wife-the has 'I-guess' no colours seen
- (37) Manden har vist ingen kasser haft. Man-the has 'I-guess' no boxes had
- (38) Konen har vist ingen fisk fanget. Wife-the has 'I-guess' no fish caught
- (39) Eksperten har vist ingen bøger læst. Expert-the has 'I-guess' no books read
- (40) Katten har vist ingen fisk haft. Cat-the has 'I-guess' no fish had
- (41) Lægen har vist ingen huse set. Doctor-the has 'I-guess' no houses seen
- (42) Lægen har vist ingen penge taget. Doctor-the has 'I-guess' no money taken
- (43) Manden har vist ingen frugter købt. Man-the has 'I-guess' no fruit bought
- (44) Eksperten har vist ingen chancer fået. Expert-the has 'I-guess' no chances gotten
- (45) Konen har vist ingen venner set. Wife-the has 'I-guess' no friends seen
- (46) *Fuglen har vist ingen korn hørt. Bird-the has 'I-guess' no seeds heard
- (47) *Konen har vist ingen ideer spist. *Wife-the has 'I-guess' no ideas eaten*
- (48) *Kirurgen har vist ingen chancer læst. Surgeon-the has 'I-guess' no chances read

- (49) *Bordet har vist ingen prøver haft. *Table-the has 'I-guess' no tests had*
- (50) *Eksperten har vist ingen huse spist. Expert-the has 'I-guess' no houses eaten
- (51) *Lægen har vist ingen fisk læst. Doctor-the has 'I-guess' no fish read
- (52) *konen har vist ingen farver hørt. Wife-the has 'I-guess' no colours heard
- (53) *Manden har vist ingen lyde købt. Man-the has 'I-guess' no sounds bought
- (54) *Æsken har vist ingen korn fundet. Box-the has 'I-guess' no seeds found
- (55) *Maskinen har vist ingen bøger læst. Machine-the has 'I-guess' no books read
- (56) *Tøjet har vist ingen gaver haft. Clothes-the have 'I-guess' no presents had
- (57) *Fuglen har vist ingen sko købt. Bird-the has 'I-guess' no shoes bought
- (58) *Katten har vist ingen mål taget. Cat-the has 'I-guess' no measures taken
- (59) *Bordet har vist ingen farver set. *Table-the has 'I-guess' no colours seen*
- (60) *Æsken har vist ingen fejl fundet. Box-the has 'I-guess' no errors found

Condition B: Subj Aux ikke ('not') Verb nogen ('any') NP

- (1) Kirurgen har ikke læst nogen bøger.
- (2) Lægen har ikke taget nogen prøver.
- (3) Manden har ikke hørt nogen lyde.
- (4) Konen har ikke haft nogen sko.
- (5) Eksperten har ikke lavet nogen fejl.
- (6) Konen har ikke fået nogen penge.
- (7) Manden har ikke haft nogen gaver.
- (8) Lægen har ikke hørt nogen lyde.
- (9) Æsken har ikke haft nogen hjørner.
- (10) Tøjet har ikke haft nogen farver.
- (11) Maskinen har ikke lavet nogen lyde.
- (12) Bordet har ikke haft nogen hjørner.
- (13) Katten har ikke spist nogen fisk.
- (14) Fuglen har ikke fundet nogen korn.
- (15) Manden har ikke fanget nogen fisk.
- (16) Konen har ikke fået nogen ideer.
- (17) Manden har ikke taget nogen mål.
- (18) Konen har ikke fundet nogen frugter.
- (19) Eksperten har ikke købt nogen huse.
- (20) Katten har ikke hørt nogen lyde.
- (21) Kirurgen har ikke taget nogen chancer.
- (22) Lægen har ikke fundet nogen fejl.
- (23) Manden har ikke haft nogen venner.
- (24) Konen har ikke fundet nogen kasser.
- (25) Eksperten har ikke taget nogen prøver.
- (26) Konen har ikke købt nogen huse.
- (27) Manden har ikke fået nogen penge.
- (28) Lægen har ikke fundet nogen bøger.
- (29) Æsken har ikke haft nogen farver.
- (30) Tøjet har ikke haft nogen fejl.
- (31) Maskinen har ikke lavet nogen fejl.

- (32) Bordet har ikke haft nogen farver.
- (33) Katten har ikke lavet nogen lyde.
- (34) Fuglen har ikke spist nogen frugter.
- (35) Manden har ikke købt nogen bøger.
- (36) Konen har ikke set nogen farver.
- (37) Manden har ikke haft nogen kasser.
- (38) Konen har ikke fanget nogen fisk.
- (39) Eksperten har læst ikke nogen bøger.
- (40) Katten har ikke haft nogen fisk.
- (41) Lægen har ikke set nogen huse.
- (42) Lægen har ikke taget nogen penge.
- (43) Manden har ikke købt nogen frugter.
- (44) Eksperten har ikke fået nogen chancer.
- (45) Konen har ikke set nogen venner.
- (46) *Fuglen har ikke hørt nogen korn.
- (47) *Konen har ikke spist nogen ideer.
- (48) *Kirurgen har ikke læst nogen chancer.
- (49) *Bordet har ikke haft nogen prøver.
- (50) *Eksperten har ikke spist nogen huse.
- (51) *Lægen har ikke læst nogen fisk.
- (52) *konen har ikke hørt nogen farver.
- (53) *Manden har ikke købt nogen lyde.
- (54) *Æsken har ikke fundet nogen korn.
- (55) *Maskinen har ikke læst nogen bøger.
- (56) *Tøjet har ikke haft nogen gaver.
- (57) *Fuglen har ikke købt nogen sko.
- (58) *Katten har ikke taget nogen mål.
- (59) *Bordet har ikke set nogen farver.
- (60) *Æsken har ikke fundet nogen fejl.

Condition C: Hvilke ('which') NP Aux Subj ikke Verb

- (1) Hvilke bøger har kirurgen ikke læst?
- (2) Hvilke prøver har lægen ikke taget?
- (3) Hvilke lyde har manden ikke hørt?
- (4) Hvilke sko har konen ikke haft?
- (5) Hvilke fejl har eksperten ikke lavet?
- (6) Hvilke penge har konen ikke fået?
- (7) Hvilke gaver har manden ikke haft?
- (8) Hvilke lyde har lægen ikke hørt?
- (9) Hvilke hjørner har æsken ikke haft?
- (10) Hvilke farver har tøjet ikke haft?
- (11) Hvilke lyde har maskinen ikke lavet?
- (12) Hvilke hjørner har bordet ikke haft?
- (13) Hvilke fisk har katten ikke spist?
- (14) Hvilke korn har fuglen ikke fundet?
- (15) Hvilke fisk har manden ikke fanget?
- (16) Hvilke ideer har konen ikke fået?
- (17) Hvilke mål har manden ikke taget?
- (18) Hvilke frugter har konen ikke fundet?
- (19) Hvilke huse har eksperten ikke købt?
- (20) Hvilke lyde har katten ikke hørt?
- (21) Hvilke chancer har kirurgen ikke taget?
- (22) Hvilke fejl har lægen ikke fundet?
- (23) Hvilke venner har manden ikke haft?
- (24) Hvilke kasser har konen ikke fundet?
- (25) Hvilke prøver har eksperten ikke taget?
- (26) Hvilke huse har konen ikke købt?
- (27) Hvilke penge har manden ikke fået?
- (28) Hvilke bøger har lægen ikke fundet?
- (29) Hvilke farver har æsken ikke haft?
- (30) Hvilke fejl har tøjet ikke haft?
- (31) Hvilke fejl har maskinen ikke lavet?

- (32) Hvilke farver har bordet ikke haft?
- (33) Hvilke lyde har katten ikke lavet?
- (34) Hvilke frugter har fuglen ikke spist?
- (35) Hvilke bøger har manden ikke købt?
- (36) Hvilke farver har konen ikke set?
- (37) Hvilke kasser har manden ikke haft?
- (38) Hvilke fisk har konen ikke fanget?
- (39) Hvilke bøger har eksperten ikke læst?
- (40) Hvilke fisk har katten ikke haft?
- (41) Hvilke huse har lægen ikke set?
- (42) Hvilke penge har lægen ikke taget?
- (43) Hvilke frugter har manden ikke købt?
- (44) Hvilke chancer har eksperten ikke fået?
- (45) Hvilke venner har konen ikke set?
- (46) *Hvilke korn har fugle ikke hørt?
- (47) *Hvilke ideer har konen ikke spist?
- (48) *Hvilke chancer har kirurgen ikke læst?
- (49) *Hvilke prøver har bordet ikke haft?
- (50) *Hvilke huse har eksperten ikke spist?
- (51) *Hvilke fisk har lægen ikke læst?
- (52) *Hvilke farver har konen ikke hørt?
- (53) *Hvilke lyde har manden ikke købt?
- (54) *Hvilke korn har æsken ikke fundet?
- (55) *Hvilke bøger har maskinen ikke læst?
- (56) *Hvilke gaver har tøjet ikke haft?
- (57) *Hvilke sko har fuglen ikke købt?
- (58) *Hvilke mål har katten ikke taget?
- (59) *Hvilke farver har bordet ikke set?
- (60) *Hvilke fejl har æsken ikke fundet?

Condition D: Aux Subj ikke ('not') Verb nogen ('any') NP?

- (1) Har kirurgen ikke læst nogen bøger?
- (2) Har lægen ikke taget nogen prøver?
- (3) Har manden ikke hørt nogen lyde?
- (4) Har konen ikke haft nogen sko?
- (5) Har eksperten ikke lavet nogen fejl?
- (6) Har konen ikke fået nogen penge?
- (7) Har manden ikke haft nogen gaver?
- (8) Har lægen ikke hørt nogen lyde?
- (9) Har æsken ikke haft nogen hjørner?
- (10) Har tøjet ikke haft nogen farver?
- (11) Har maskinen ikke lavet nogen lyde?
- (12) Har bordet ikke haft nogen hjørner?
- (13) Har katten ikke spist nogen fisk?
- (14) Har fuglen ikke fundet nogen korn?
- (15) Har manden ikke fanget nogen fisk?
- (16) Har konen ikke fået nogen ideer?
- (17) Har manden ikke taget nogen mål?
- (18) Har konen ikke fundet nogen frugter?
- (19) Har eksperten ikke købt nogen huse?
- (20) Har katten ikke hørt nogen lyde?
- (21) Har Kirurgen ikke taget nogen chancer?
- (22) Har lægen ikke fundet nogen fejl?
- (23) Har manden ikke haft nogen venner?
- (24) Har konen ikke fundet nogen kasser?
- (25) Har eksperten ikke taget nogen prøver?
- (26) Har konen ikke købt nogen huse?
- (27) Har manden ikke fået nogen penge?
- (28) Har lægen ikke fundet nogen bøger?
- (29) Har æsken ikke haft nogen farver?
- (30) Har tøjet ikke haft nogen fejl?
- (31) Har maskinen ikke lavet nogen fejl?
- (32) Har bordet ikke haft nogen farver?
- (33) Har katten ikke lavet nogen lyde?

- (34) Har fuglen ikke spist nogen frugter?
- (35) Har manden ikke købt nogen bøger?
- (36) Har konen ikke set nogen farver?
- (37) Har manden ikke haft nogen kasser?
- (38) Har konen ikke fanget nogen fisk?
- (39) Har eksperten læst ikke nogen bøger?
- (40) Har katten ikke haft nogen fisk?
- (41) Har lægen har ikke set nogen huse?
- (42) Har lægen ikke taget nogen penge?
- (43) Har manden ikke købet nogen frugter?
- (44) Har eksperten ikke fået nogen chancer?
- (45) Har konen ikke set nogen venner?
- (46) *Har fuglen ikke hørt nogen korn?
- (47) *Har konen ikke spist nogen ideer?
- (48) *Har kirurgen ikke læst nogen chancer?
- (49) *Har bordet ikke haft nogen prøver?
- (50) *Har eksperten ikke spist nogen huse?
- (51) *Har lægen ikke læst nogen fisk?
- (52) *Har konen ikke hørt nogen farver?
- (53) *Har manden ikke købt nogen lyde?
- (54) *Har æsken ikke fundet nogen korn?
- (55) *Har maskinen ikke læst nogen bøger?
- (56) *Har tøjet ikke haft nogen gaver?
- (57) *Har fuglen ikke købt nogen sko?
- (58) *Har katten ikke taget nogen mål?
- (59) *Har bordet ikke set nogen farver?
- (60) *Har æsken ikke fundet nogen fejl?

D. Activation Clusters

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
$p_{\text{corrected}}$	equiv k	$p_{\text{uncorr.}}$	$p_{ m FWE}$	$p_{ m FDR}$	Т	equiv Z	$p_{uncorr.}$	x, y ,z {mm}
0.000	433	0.000	0.000	0.000	6.73	6.71	0.000	-50, 20, -8
			0.987	0.033	3.60	3.60	0.000	-38, 14, -10
0.000	290	0.000	0.003	0.000	5.40	5.39	0.000	-56, -10, -18
			0.182	0.003	4.47	4.47	0.000	-56, 4, -28
			0.941	0.024	3.74	3.74	0.000	-64, -16, -16
0.009	131	0.001	0.038	0.001	4.87	4.86	0.000	52, 18, -4
0.138	59	0.019	0.123	0.002	4.58	4.57	0.000	-24, 0, 6
0.117	63	0.016	0.143	0.002	4.54	4.53	0.000	-32, -82, -32
0.072	75	0.010	0.167	0.003	4.50	4.49	0.000	10, -86, -26
0.015	118	0.002	0.169	0.003	4.49	4.49	0.000	-62, -34, -4
			0.764	0.015	3.94	3.94	0.000	-64, -22, -4
0.446	31	0.076	0.333	0.005	4.29	4.29	0.000	-4, 24, 58
0.260	44	0.039	0.489	0.008	4.16	4.15	0.000	-40, -54, -44
0.150	57	0.021	0.565	0.009	4.10	4.09	0.000	58, -10, -20
0.113	64	0.015	0.627	0.011	4.05	4.05	0.000	32, -84, -32
			0.853	0.018	3.86	3.85	0.000	24, -88, -34
0.796	15	0.205	0.863	0.019	3.85	3.84	0.000	38, 18, -12
0.882	11	0.275	0.954	0.026	3.71	3.71	0.000	38, 48, 2

Main movement effect, FFX (AC>BD), FDR p=0.05, threshold=10

Table shows 3 local maxima more than 8.0mm apart

Height threshold: T = 3.40, p = 0.000 (1.000)Extent threshold: k = 10 voxels, p = 0.298 (0.901)Expected voxels per cluster, $\langle k \rangle = 9.979$ Expected number of clusters, $\langle c \rangle = 2.31$ Expected false discovery rate, $\langle = 0.05$ Degrees of freedom = [1.0, 3905.0] Smoothness FWHM = 10.1 10.1 8.8 {mm}, = 5.1 5.1 4.4 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1730.8 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 113.05 voxels)

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
ncorrected	equiv k	nuncorr	newe		T	equiv Z	nuncorr	$x v z \{mm\}$
<u><i>P</i> conceited</u>	828	0.000	0.000	0.000	7 57	7 54	0.000	-50 22 -10
0.000	020	0.000	0.000	0.000	5 11	5 10	0.000	-52 20 4
			0.082	0.000	4 68	4 67	0.000	-52, 26, 16
0 000	364	0.000	0.000	0.000	5 96	5 94	0.000	-66 -38 -2
0.000	501	0.000	0.925	0.016	3 77	3 76	0.000	-52 -10 -20
			0 964	0.019	3 69	3 68	0.000	-62 -22 -16
0 000	352	0 000	0.001	0.000	5 64	5 62	0.000	12 -88 -28
0.000	002	0.000	0.674	0.008	4 01	4 01	0.000	34 -84 -36
0.013	153	0.001	0.057	0.001	4.77	4.76	0.000	-54, -56, 20
			0.800	0.011	3.91	3.91	0.000	-46, -60, 16
			1.000	0.037	3.39	3.39	0.000	-42, -54, 20
0.001	247	0.000	0.137	0.001	4.55	4.54	0.000	56, 20, -10
			0.230	0.002	4.41	4.40	0.000	54, 18, -2
			0.990	0.025	3.58	3.58	0.000	58, 30, 0
0.193	69	0.018	0.160	0.002	4.51	4.50	0.000	-42, 6, 48
			0.710	0.009	3.99	3.98	0.000	-38, 10, 40
0.347	52	0.036	0.448	0.005	4.19	4.19	0.000	-2, 24, 56
0.925	16	0.221	0.499	0.005	4.15	4.15	0.000	-54, 8, -26
0.055	106	0.005	0.670	0.008	4.02	4.01	0.000	22, -96, -10
			0.723	0.009	3.98	3.97	0.000	16, -98, -4
0.869	20	0.174	0.748	0.009	3.96	3.95	0.000	-2, 30, 40
0.500	41	0.059	0.778	0.010	3.93	3.92	0.000	-36, 56, 14
0.884	19	0.184	0.803	0.011	3.91	3.90	0.000	-22, -2, 6
0.549	38	0.068	0.829	0.011	3.88	3.88	0.000	54, 18, 24
0.836	22	0.155	0.867	0.013	3.84	3.84	0.000	-60, -20, -4
0.853	21	0.164	0.944	0.017	3.73	3.73	0.000	-46, -74, 28
0.516	40	0.062	0.951	0.017	3.72	3.71	0.000	-32, 52, 0
			0.971	0.020	3.67	3.66	0.000	-24, 50, 12
0.957	13	0.269	0.997	0.029	3.51	3.51	0.000	-42, 16, 22
0.965	12	0.288	0.999	0.032	3.46	3.45	0.000	-28, -84, -30

Wh-movement, FFX (C>D), FDR p=0.05, threshold=10

Height threshold: T = 3.25, p = 0.001 (1.000)Extent threshold: k = 10 voxels, p = 0.332 (0.979)Expected voxels per cluster, $\langle k \rangle = 11.475$ Expected number of clusters, $\langle c \rangle = 3.88$ Expected false discovery rate, $\langle = 0.05$ Degrees of freedom = [1.0, 3905.0] Smoothness FWHM = 10.1 10.1 8.8 {mm}, = 5.1 5.1 4.4 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1730.8 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 113.05 voxels)

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
$p_{\text{corrected}}$	equiv k	$p_{\text{uncorr.}}$	$p_{ m FWE}$	$p_{ m FDR}$	Т	equiv Z	$p_{uncorr.}$	x, y ,z {mm}
0.002	273	0.000	0.070	0.066	4.72	4.71	0.000	-60, -8, -20
			0.978	0.174	3.64	3.64	0.000	-42, -10, -20
			0.990	0.178	3.58	3.58	0.000	-54, 2, -14
0.247	84	0.016	0.458	0.111	4.18	4.18	0.000	-20, 6, -8
			1.000	0.214	3.30	3.30	0.000	-14, 10, -16
0.284	79	0.019	0.550	0.121	4.11	4.11	0.000	-40, -54, -44
0.757	40	0.081	0.598	0.121	4.07	4.07	0.000	-32, 0, 10
0.061	134	0.004	0.711	0.124	3.99	3.98	0.000	-34, 12, -14
			1.000	0.205	3.36	3.36	0.000	-48, 10, -14
			1.000	0.220	3.26	3.26	0.001	-46, 18, -18
0.899	29	0.132	0.796	0.136	3.91	3.91	0.000	24, 28, -16
0.938	25	0.160	0.840	0.137	3.87	3.87	0.000	-34, -82, -34
0.611	50	0.054	0.961	0.162	3.70	3.69	0.000	32, -38, 52
			1.000	0.234	3.14	3.14	0.001	38, -30, 48
0.993	14	0.287	0.981	0.174	3.63	3.63	0.000	32, 4, -30
0.993	14	0.287	0.982	0.174	3.62	3.62	0.000	16, -2, 74
0.981	18	0.229	0.983	0.174	3.62	3.62	0.000	-52, -22, 56
0.953	23	0.176	0.984	0.174	3.61	3.61	0.000	-16, -36, -14
0.988	16	0.256	0.999	0.201	3.41	3.41	0.000	-28, -20, -18
0.960	22	0.185	1.000	0.201	3.40	3.40	0.000	8, -10, 56

NEG-shift, FFX (A>B), uncorrected p=0.001, threshold=10

Table shows 3 local maxima more than 8.0mm apart Height threshold: T = 3.09, p = 0.001 (1.000)Extent threshold: k = 10 voxels, p = 0.369 (0.998)Expected voxels per cluster, $\langle k \rangle = 13.372$ Expected number of clusters, $\langle c \rangle = 6.42$ Expected false discovery rate, $\langle = 0.24$ Degrees of freedom = [1.0, 3905.0] Smoothness FWHM = 10.1 10.1 8.8 {mm}, = 5.1 5.1 4.4 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1730.8 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 113.05 voxels)

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
$p_{\text{corrected}}$	equiv k	$p_{ m uncorr.}$	$p_{ m FWE}$	$p_{ m FDR}$	Т	equiv Z	$p_{uncorr.}$	x, y ,z {mm}
0.102	105	0.005	0.371	0.224	4.30	4.29	0.000	-6, -2, -10
			0.998	0.224	3.54	3.53	0.000	6, -10, -4
0.192	85	0.011	0.512	0.224	4.18	4.17	0.000	50, 0, 14
			0.994	0.224	3.59	3.58	0.000	46, -2, 22
			1.000	0.233	3.34	3.33	0.000	42, -8, 18
0.001	303	0.000	0.548	0.224	4.15	4.14	0.000	50, -14, 0
			0.813	0.224	3.94	3.93	0.000	44, 4, -2
			0.935	0.224	3.79	3.78	0.000	56, -6, -2
0.198	84	0.011	0.877	0.224	3.87	3.86	0.000	-22, -14, 10
			0.999	0.224	3.49	3.49	0.000	-20, -2, 20
			1.000	0.233	3.17	3.16	0.001	-18, -22, 8
0.407	61	0.027	0.917	0.224	3.82	3.81	0.000	12, -24, 8
			1.000	0.232	3.38	3.37	0.000	18, -30, 6
0.350	66	0.022	0.948	0.224	3.77	3.76	0.000	-40, 2, -6
0.752	38	0.071	0.978	0.224	3.69	3.68	0.000	-46, -22, 4

Well-formedness effect, FFX (Well-formed>Anomalous), uncorrected p=0.001, threshold=20

Height threshold: T = 3.10, p = 0.001 (1.000)Extent threshold: k = 20 voxels, p = 0.178 (0.970)Expected voxels per cluster, $\langle k \rangle = 11.742$ Expected number of clusters, $\langle c \rangle = 3.51$ Expected false discovery rate, $\langle = 0.23$ Degrees of freedom = [1.0, 1705.0] Smoothness FWHM = 9.8 9.8 8.3 {mm}, = 4.9 4.9 4.1 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1966.4 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 99.50 voxels)

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
$p_{\text{corrected}}$	equiv k	$p_{ m uncorr.}$	$p_{ m FWE}$	$p_{ m FDR}$	Т	equiv Z	$p_{ m uncorr.}$	x, y ,z {mm}
0.009	207	0.001	0.245	0.139	4.39	4.38	0.000	-36, 34, 8
			0.498	0.139	4.15	4.15	0.000	-28, 26, 8
			0.961	0.173	3.70	3.69	0.000	-34, 26, 22
0.090	120	0.005	0.288	0.139	4.34	4.33	0.000	14, 44, -14
0.009	209	0.001	0.330	0.139	4.30	4.29	0.000	-4, 32, 8
			0.848	0.156	3.86	3.86	0.000	8, 34, 8
			0.969	0.173	3.67	3.67	0.000	-4, 42, 10
0.920	27	0.145	0.944	0.173	3.73	3.73	0.000	-34, -76, 28
0.972	20	0.206	0.956	0.173	3.71	3.70	0.000	-14, 18, -6
0.960	22	0.185	0.994	0.184	3.55	3.55	0.000	28, 50, 6
0.995	13	0.305	1.000	0.252	3.34	3.34	0.000	14, -66, 26

Declarative Force, FFX (AB>CD), uncorrected p=0.001, threshold=10

Height threshold: T = 3.09, p = 0.001 (1.000)Extent threshold: k = 10 voxels, p = 0.369 (0.998)Expected voxels per cluster, $\langle k \rangle = 13.372$ Expected number of clusters, $\langle c \rangle = 6.42$ Expected false discovery rate, $\langle = 0.30$ Degrees of freedom = [1.0, 3905.0] Smoothness FWHM = 10.1 10.1 8.8 {mm}, = 5.1 5.1 4.4 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1730.8 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 113.05 voxels)

cluster	cluster	cluster	voxel	voxel	voxel	voxel	voxel	
$p_{\text{corrected}}$	equiv k	$p_{ m uncorr.}$	$p_{ m FWE}$	$p_{ m FDR}$	Т	equiv Z	$p_{ m uncorr.}$	x, y ,z {mm}
0.318	75	0.022	0.431	0.414	4.20	4.20	0.000	-8, -74, 40
0.865	32	0.115	0.621	0.414	4.06	4.05	0.000	-40, 4, 56
0.066	131	0.004	0.674	0.414	4.01	4.01	0.000	-58, -58, 8
			0.949	0.414	3.72	3.72	0.000	-54, -70, 12
0.977	19	0.217	0.860	0.414	3.85	3.85	0.000	62, 22, 14
0.852	33	0.110	0.951	0.414	3.72	3.71	0.000	-12, -84, -6
0.728	42	0.075	0.978	0.432	3.64	3.64	0.000	0, -92, 28
			1.000	0.464	3.30	3.30	0.000	8, -96, 26
0.985	17	0.242	0.986	0.432	3.60	3.60	0.000	-50, -82, 4

Interrogative Force, FFX(CD>AB), uncorrected p=0.001, threshold=10

Height threshold: T = 3.09, p = 0.001 (1.000)Extent threshold: k = 10 voxels, p = 0.369 (0.998)Expected voxels per cluster, $\langle k \rangle = 13.372$ Expected number of clusters, $\langle c \rangle = 6.42$ Expected false discovery rate, $\langle = 0.57$ Degrees of freedom = [1.0, 3905.0] Smoothness FWHM = 10.1 10.1 8.8 {mm}, = 5.1 5.1 4.4 {voxels} Search vol: 1675000 cmm; 209375 voxels; 1730.8 resels Voxel size: [2.0, 2.0, 2.0] mm, (1 resel = 113.05 voxels)

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