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Grammar, Concepts, and Interfaces Across Languages

The Syntax and Semantics of Translation

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DOCTORAL DISSERTATION

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Abstract

Bilingual speakers can commonly translate between languages even without formal training. This dissertation develops a novel theoretical analysis of this impressive capacity, building on prior work in linguistics, the cognitive science of concepts, and the philosophy of language. In the empirical part, the resulting analysis is applied to case-studies on Finnish-English translation.

Working within the *Distributed Morphology* framework, I propose that "languages" in bilingual cognition can be allocated to the syntax-phonology interface. This departs from prominent lexicalist accounts of language differentiation. It removes the need for top-down enforcement of language membership, while still allowing lexical, syntactic, and semantic variation between languages as indirect consequences of pronounceability. On the syntax-semantics interface, I adopt the *conjunctivist* account developed by Pietroski, built around neo-Davidsonian event semantics. I further append it with a recent proposal of treating concepts as *pointers* to memory locations. The approach is compatible with linguistic variation across concepts, without succumbing to linguistic relativism.

Translation has typically been taken to require semantic *overlap*. However, I argue that this idea is untenable, and instead treat translation as *inference* between concepts linked to different languages. I propose that the inferential relation involved is *immediate entailment*, which selects a maximally informative target among those entailed by the source (in the discourse). Given conjunctivism, this allows explaining the translation of complex phrases based on their constituents, which is essential for the *productivity* of translation. It also accommodates multiple findings on *translation universals* featured in prior literature.

The empirical part of the dissertation analyzes two kinds of *translation shifts* between Finnish and English, derived from a parallel corpus. *Unit shifts* translate a single word to multiple words, and *word order shifts* change linear order when translating two words. Of these translation shifts, 98.9% are accounted for by 21 points of variation, grounded in Finnish and English grammar. I connect these observations to the overall theoretical framework, illustrating its applicability for explaining translation between typologically divergent languages.

Keywords: translation, bilingualism, syntax, semantics, concept, cognition, Distributed Morphology, conjunctivism, translation shift, Finnish, English

Helsingin yliopisto, Humanistinen tiedekunta

Tommi Buder-Gröndahl

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Tiivistelmä

Kaksikieliset puhujat osaavat usein kääntää kielten välillä jopa ilman erillistä koulutusta. Tämä väitöskirja kehittää uuden teoreettisen analyysin tästä merkittävästä kyvystä pohjaten aiempaan tutkimukseen kielitieteestä, käsitteiden kognitiotieteestä sekä kielifilosofiasta. Empiirinen osio soveltaa analyysia suomen ja englannin väliseen kääntämiseen.

Distributed Morphology -viitekehyksen pohjalta esitän, että kaksikielisen kognition ”kielet” paikantuvat syntaksin ja fonologian rajapintaan. Tämä poikkeaa yleisestä leksikalistisesta käsityksestä koskien kielten eriytymistä. Kieliä ei enää rajata ylhäältä käsin, mutta leksikaaliset, syntaktiset ja semanttiset erot voivat edelleen seurata epäsuorasti ilmaisujen lausuttavuudesta. Syntaksin ja semantiikan rajapinnan analysoin Pietroskin kehittämän *konjunktivistismin* kautta, joka perustuu uusdavidsonilaiseen tapahtumasemantiikkaan. Liitän tämän viimeaikaiseen näkemykseen käsitteistä *osoittimina* muistipaikkoihin. Teoria sallii käsitteellisen variaation kielten välillä, mutta välttää kielellisen relativismin.

Kääntämisen on tyypillisesti oletettu vaativan semanttista *päällekkäisyyttä*. Pidän kuitenkin tätä ajatusta kestämättömänä. Sen sijaan käsittelen kääntämistä eri kieliin liittyvien käsitteiden välisenä *päättelynä*. Esitän, että kääntämiseen tarvittava päättelysuhde on *välitön seuraus*, jossa valitaan informatiivisin kohdekäsite kaikkien lähdekäsitteen seurausten joukosta (diskurssi huomioiden). Konjunktivismiin nojaten tämän kautta voidaan selittää monimutkaisten ilmauksien kääntäminen niiden osien mukaan, mikä on keskeistä kääntämisen *produktiivisuuden* kannalta. Analyysi sopii myös yhteen aiemmassa tutkimuksessa huomioitujen *käännösuniversaaleja* koskevien havaintojen kanssa.

Empiirinen osio analysoi kahdenlaisia käännöskorpuksesta kerättyjä *käännössiirtymiä* suomen ja englannin välillä. *Yksikkösiirtymissä* yksi sana kääntyy useammaksi, ja *sanajärjestyssiirtymät* vaihtavat järjestystä käännettyjen sanojen välillä. Siirtymistä 98.9% selittyy 21 suomen ja englannin välisen kieliopillisen eron perusteella. Liitän nämä havainnot väitöskirjassa kehittyyn yleiseen teoreettiseen viitekehykseen, mikä osoittaa sen selitysvoimasta koskien kääntämistä typologisesti eroavien kielten välillä.

Avainsanat: kääntäminen, kaksikielisyys, syntaksi, semantiikka, käsite, kognitio, Distributed Morphology, konjunktivismi, käännössiirtymä, suomi, englanti

Preface

This dissertation has been a long time in the making, initial sketches dating back to 2015. Throughout my academic life, I have been drawn to "big questions": how does language work, how does conceptual thought work, and how are they related? These keep me up at night and even during the day. I really wanted to tackle them in my PhD, which predictably led to being given the astute advise of setting realistic goals. The challenge thus became to find a concrete and empirically grounded topic without discarding the big questions. I am not sure when I first considered translation, but I remember expecting to find a substantial literature on its connections to contemporary linguistic theory. To my surprise, I found far less material than I had anticipated. This made me realize the need to reconsider the foundations of translation.

In 2016 I was working as a research assistant at Aalto University, and received a great opportunity to pursue a doctoral degree in computer science. This was well worth taking; but it soon became clear that my ongoing theoretical study on translation was not a proper fit there. Giving it up was not a serious option either. After some deliberation, we decided that I could work half-time on two dissertations, which I did for a while until switching to full-time work at Aalto. The present dissertation was put on hiatus for some years, but I was able to finalize it after receiving my DSc degree from Aalto in 2021. This unusual arrangement would not have been possible without the enduring support of my supervisors.

Prof. Terje Lohndal has been an outstanding supervisor in every respect, providing detailed and extremely helpful comments for every sketch. He has been able to pinpoint exactly the right spots to modify, as well as to suggest the best direction to take whenever I have been unsure. His own work and extensive knowledge of linguistics have also provided major inspiration to me, and continue to do so. Dr. Otto Lappi has supported my research career since my first year at the University of Helsinki, and his encouragement is a major reason I have been able to keep this project going. He originally introduced me to the study of concepts in philosophy and cognitive science, which has never stopped captivating me since.

I am grateful to Prof. Paul Pietroski and Prof. John Collins for pre-examination, and to Prof. Pietroski for serving the opponent role in my defence. I also want to thank Prof. Phoevos Panagiotidis and Dr. Henri Kauhanen for forming my thesis committee, as well as for many fascinating discussions over the years. I was especially glad to be invited by Prof. Panagiotidis to visit the University of Cyprus in 2019 and get valuable feedback.

The whole cognitive science crew at the University of Helsinki has been essential for my academic development; in particular Dr. Saara Huhmarniemi for setting a first-rate example of doing linguistics, Dr. Anna-Mari Wallenberg for carrying the philosophical torch, and Dr. Jami Pekkanen for advancing my thinking by providing much-needed challenges to my views. I am also indebted to Prof. Riikka Möttönen, Prof. Martti Vainio, and Prof. Jörg Tiedemann for their support. Outside of studies and work, the cognitive science organization for students and alumni has given rise to numerous fun and memorable events.

During my time at Aalto University, the unusual situation of having two doctoral dissertations in the making required significant flexibility and encouragement on part of my other dissertation's supervisor, Prof. N. Asokan. I thank him for allowing me to keep this PhD project in the radar even when I was unable to work on it actively, and supporting my return to it after finishing my DSc dissertation.

This research would not have gotten off the ground without the University of Helsinki library or the public libraries of Finland. I have an immense gratitude to library workers for upholding this indispensable institution, and the Finnish public for keeping it alive.

My family and friends deserve the credit for setting my priorities right and reminding me not to get completely lost in research; especially my mother Laura and my group of friends, in particular Heidi, Iina, Erno, Viljami, and Aino.

I dedicate this dissertation to my wife Annemarie, who is responsible for what is best in my life and surpasses conceptualization.

Helsinki, 2023
Tommi Buder-Gröndahl

Contents

Acronyms

C-I conceptual-intentional.

S-M sensory-motor.

CTM computational theory of mind.

DM Distributed Morphology.

DNN deep neural network.

FLB faculty of language in the broad sense.

FLN faculty of language in the narrow sense.

fseq functional sequence.

G&B Government & Binding.

LCA Linear Correspondence Axiom.

MT machine translation.

MTP Merge-Translation Principle.

NLP natural language processing.

NS Narrow Syntax.

P&P Principles and Parameters.

RHM Revised Hierarchical Model.

RT Relevance Theory.

SE source expression.

SL source language.

SO syntactic object.

TE target expression.

TL target language.

UG universal grammar.

UTAH Uniformity of Theta Assignment Hypothesis.

VI Vocabulary Item.

Linguistic glossary

1 first person.

2 second person.

3 third person.

ABL ablative case.

ACC accusative case.

ADE adessive case.

ADJ adjective.

ADV adverb.

AFF affix.

ALL allative case.

AUX auxiliary verb.

CAUS causative.

CMP complementizer.

CNN connective.

COMP comparative.

COND conditional.

COP copula verb.

DAT dative case.

DEF definite.

DEG degree adverbial.

DET determiner.

ELA elative case.

ESS essive case.

EXP expletive pronoun.

FEM feminine gender.

FOC focus.

GEN genitive case.

ILL illative case.

IMP imperative.

INE inessive case.

INF infinitive.

INFL inflection.

MASC masculine gender.

N noun.

NEG negation.

NEUT neutral gender.

NOM nominative case.

NUM numeral.

P pre-/postposition = adposition.

PART partitive case.

PASS passive voice.

PAST past tense.

PCP participle.

PERF perfective aspect.

PL plural.

POSS possessive suffix.

PRES present tense.

PRN pronoun.

PROG progressive aspect.

Q question particle.

REL relative pronoun.

SG singular.

SUPERL superlative.

TRANSL translative case.

V verb.

WH *wh*-pronoun.

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Chapter 1

Introduction

It has been estimated that at least half of the world's population is bilingual (Grosjean 2021).[1] Somehow, a bilingual speaker must distinguish between two languages while also allowing them to interact. Their complete isolation would preclude tasks that require inter-lingual comparison, arguably the most prominent of which is *translation*. Even if conceptual thought is influenced by language (e.g. Boroditsky 2001, Boroditsky et al. 2003, Regier et al. 2010), translation illustrates that it can also be mediated across languages.

In addition to being a major professional industry, translation can also emerge spontaneously. Even without formal training, bilingual speakers often display an ability to translate at a young age (Malakoff and Hakuta 1991, Valdés 2003, Dorner et al. 2008, Daniel and Pacheco 2016). This suggests that it is not an isolated cognitive ability, but arises as a consequence of bilingual competence itself (Harris 1976, Harris and Sherwood 1978, Malakoff 1992).

This dissertation develops a novel theoretical account of translation as part of a bilingual speaker's cognitive competence, building on prior work in linguistics, the cognitive science of concepts, and the philosophy of language. The resulting framework is then applied to empirical data on Finnish-English translation, obtained via a combination of automatic and manual corpus analysis.

The present introductory chapter provides a brief overview of the main research questions (Section 1.1), theoretical framework (Section 1.2), methodology (Section 1.3), and empirical results (Section 1.4), along with an outline of forthcoming chapters (Section 1.5).

[1] I use the term "bilingual" of both bi- and multilingual speakers, competent in *at least* two languages.

1.1 Research questions

I examine translation from the *I-language* perspective, which focuses on an individual speaker's cognitive architecture (Chomsky 1986a). To begin with, translation can be thought of either as a *process* of producing a target expression from a source expression, or as a *relation* that obtains between such expressions. The first of these concerns linguistic *performance*, whereas the second concerns the *competence* underlying it (Chomsky 1965). This dissertation takes the latter approach, treating translation as a relation between the source and target expression based on their respective semantic interpretations. The generic research question is, thus, how the architecture of bilingual I-language can give rise to such relations. I further divide this question into three main parts.

First, language differentiation is foundational for translation, but the theoretical status of "languages" has remained unclear. In the standard socio-normative reading, language identities are heavily dependent on geo-politics, and hence do not reside in I-language at all (Chomsky 2000b, Lightfoot 2011). Yet, a bilingual I-language should maintain some kind of a distinction between languages to count as bilingual in the first place.[2] This motivates the first research question: *how are languages differentiated in bilingual cognition?*

Second, as a semantic relation, translation involves *concepts* that provide the semantic interpretations of linguistic expressions. The analysis of translation thus fundamentally hinges on how concepts are structured, combined, and interconnected within human cognition. Furthermore, the link between concepts and language(s) is essential for making translation possible, but also brings forth the paramount challenge of linguistic relativity. The second research question is thus: *how are concepts constituted and related to language(s)?*

Third, the most central theoretical question tackled in this dissertation concerns the conceptual relation underlying translation. Initially, it might seem trivial that translation requires the same concepts to be used for interpreting the source and target expression. However, I argue that such accounts are fundamentally flawed, and that translation does not even mandate overlap between concepts. Consequently, a principal goal of the dissertation is to provide an alternative to conceptual overlap as the basis of translation. The third research question thus turns out to be anything but trivial: *what conceptual relation is required for translation?*

[2]This remains true even if every I-language turns out to be bilingual in some sense, as suggested by Roeper (1999). For such a hypothesis to be informative, the difference between monolingual and bilingual I-language needs to be theoretically relevant, even if only the latter was actually manifested.

To recap, I identify three theoretical research questions, repeated below as Q1–Q3:

Q1. How are languages differentiated in bilingual cognition?

Q2. How are concepts constituted and related to language(s)?

Q3. What conceptual relation is required for translation?

In addition to laying out the theoretical framework for answering Q1–Q3, I evaluate it on empirical data derived from a *parallel corpus* containing tens of thousands of example translations. Specifically, I apply this method to contrastive analysis between Finnish and English, concentrating on *translation shifts* – i.e. systematic grammatical divergences between source and target expressions. This addresses two additional research questions: the methodological Q4 and the empirical Q5:

Q4. How can parallel corpora be utilized for large-scale theoretical contrastive analysis?

Q5. How to account for observed translation shifts between Finnish and English?

In summary, the general theoretical question tackled in this dissertation is how translation can arise within bilingual cognition, given the architecture of I-language and the conceptual system. This is further divided to three parts: Q1–Q3. As secondary questions, the methodological Q4 concerns the use of parallel corpora for obtaining data for theory-driven contrastive analysis, and the empirical Q5 concerns Finnish-English translation as a case-study. I return to Q1–Q5 in the concluding Chapter 7, which summarizes my proposed answer to each.

1.2 Theoretical framework

On the general architecture of I-language, I adopt a formal account of (morpho)syntax that incorporates aspects of *Distributed Morphology* (Halle and Marantz 1993, 1994, Harley and Noyer 1999, Embick and Noyer 2007, Bobaljik 2015), the *exoskeletal* approach to argument structure (Borer 2003, 2005a,b, Åfarli 2007, Ramchand 2008, Bowers 2010, Lohndal 2014, Acedo-Matellán 2016), and analyses that ground phrase structure on *syntactic domains* (Grohmann 2003, 2011, Ramchand and Svenonius 2014, Wiltschko 2014). While the basic linguistic framework is broadly in line with the *Minimalist* strand of contemporary generative linguistics (Chomsky 1995a, Boeckx 2006, Hornstein and Grohmann 2006), I also depart from mainstream Minimalism in certain important respects.

I maintain that bilingualism has remained insufficiently analyzed, including within Minimalism. It has been standard to treat two I-language components as language-specific: the pre-syntactic *Lexicon*, and post-syntactic *PF-rules* that link the syntactic derivation to phonology (e.g. MacSwan 1999, 2000, 2005a, Richards 2008, Grimstad et al. 2014). In contrast, the language-uniformity of syntactic operations is a central tenet of Minimalism. Effectively, this requires stipulating additional Lexicon-PF links for maintaining linguistic identity across the derivation (MacSwan 2005a: 6). I argue that this superfluous complication can be avoided by taking *only PF* to be language-specific. Lexical items or syntactic phrases are indirectly language-specific if they can be pronounced via the PF-rules of one language but not those of another. In addition, I propose that PF-rules are connected to each other via positive or negative links, where "languages" can be assimilated to *maximal groups of positively connected PF-rules*. An I-language is "bilingual" if it contains (at least) two such groups of PF-rules. This provides an answer to research question Q1.

On the syntax-semantics interface, I follow the *conjunctivist* approach developed by Pietroski (2005a, 2008, 2011, 2018), where syntactic combination typically corresponds to conjunction with certain minimal additions for introducing *neo-Davidsonian* argument relations (Parsons 1990, Schein 1993, Lohndal 2014). I further combine this account with a recent analysis of concepts as *pointers* to cognitive memory locations that host pluralistic information (Quilty-Dunn 2020). Since such information is not constitutive of a concept's formal identity, this is a variant of *conceptual atomism*. However, unlike the version of atomism put forward by Fodor (1981, 1990, 1998), it is not committed either to an informational account of referential content or to strong concept-nativism. This constitutes my answer to Q2.

Notably, my approach allows concepts to be *language-specific*. While it is possible for the same concepts to link to distinct languages, this is not expected by default. But if the possibility of translation was grounded in shared concepts, their lack would result in untenable linguistic relativism. Therefore, retaining the translability of languages requires either insisting that concepts are shared across languages after all, or giving up the assumption that translation requires shared concepts. Despite its initial counter-intuitiveness, I opt for the second alternative, proposing that translation is not based on conceptual identities but *inference*.

Inferential relations validate the applicability of a concept based on the applicability of another concept (either logically or probabilistically). Crucially, the concepts do not need to be *constitutively* related. This opens up the possibility for a new account of translation: the source and target expression's conceptual interpretations should stand in an appropriate inferential relation. If this can be satisfied in the absence of identity – or even constitutive overlap – between them, translation becomes possible even across language-specific concepts. From this perspective, linguistic relativism rests on a conflation between the identity of concepts and their *commensurability*; only the latter being required for translation.

Two questions now arise: (i) what is the inferential relation required for translation, and (ii) how does its satisfaction by *complex* concepts depend on its satisfaction by their constituents? For part (i), I propose that the source should entail the target (given the discourse), and there should be no more informative target candidate entailed by the source. I call this *immediate entailment*. It strikes a balance between two *desiderata*: expressing as much as possible (*informativity*), and avoiding information not entailed by the source (*conservativity*). For part (ii), it can be shown that the immediate entailment of a complex concept typically depends on the immediate entailments of its constitutents, given conjunctivism. Crucially, this allows explaining the *productivity* of translation by the respective *compositional* semantics of the source and target expression. Together, these considerations provide an answer to Q3.

The proposed framework accounts for how translation can arise in bilingual cognition. "Languages" are groups of PF-rules, and the language-specificity of lexical/syntactic objects is indirectly determined by which groups of PF-rules are applicable to them. Concepts are compositionally combinable pointers to memory locations that store (non-constitutive) pluralistic information. The syntax-semantics interface uses only a small set of modes of combination, centered around conjunction. In translation, the conceptual interpretation of the source expression needs to immediately entail the conceptual interpretation of the target expression (given the background discourse). Importantly, the cognitive architecture proposed here has no translation-specific parts. Instead, the capacity for translation emerges from the interplay between linguistic differentiation and generic inferential relations among concepts.

In this dissertation, specific syntactic structures are only discussed to the extent needed for addressing empirical translation data. Here, analyses are derived from prior work in generative syntax concerning English (as reviewed in e.g. Adger 2003, Radford 2004, 2009, or Carnie 2013) and Finnish (e.g. Vainikka 1989, Holmberg et al. 1993, Koskinen 1998, Holmberg and Nikanne 2002, Huhmarniemi 2012), with minimal adaptations to fit the overall linguistic framework employed. Beyond this, syntactic details are not the main topic of the dissertation, which instead concentrates on the general theory of translation.

1.3 Methodology

The focus of this dissertation is on theoretical analysis. Its primary goal is to improve our understanding of translation in a manner that eschews leaving central notions unexplained – in particular, the pre-theoretical understanding of "language" and "meaning". For examining the first of these, the main analytic tools are derived from theoretical linguistics. For the second, they are predominantly drawn from cognitive science and the philosophy of language. In these theory-development parts, linguistic examples are used for purposes of illustration. In contrast, the empirical analysis of Finnish-English translation is driven by patterns found in the data itself, to which theoretical explanations are subsequently fitted.

A large-scale comparison of different theoretical frameworks would not be feasible within the range of this dissertation; instead, I build a positive case for one particular approach. I summarize the main reasons for adopting each element of the theory when introducing it. The decision to include certain arguments instead of others is based on their prevalence in the background literature as well as my own assessment of their strength. On some matters (such as the specific syntactic status of adjunction, Agree, or head-movement), I refrain from committing to any particular analysis due to their complexity and/or lack of direct relevance for the dissertation overall. I make this explicit in the text as needed.

The I-language perspective stands in contrast to both the referential/truth-conditional account of meaning employed in standard formal semantics (Montague 1970a, Lewis 1970, Heim and Kratzer 1998), as well as the emphasis on socio-cultural considerations prevalent in contemporary translation studies (e.g. Steiner 1975, Bassnett and Lefevere 1990). That being said, my approach is inclusive of others alongside it. I do not proclaim that translation is solely an I-language phenomenon; I simply aim to elucidate those aspects of I-language that are the most relevant for translation (see Chapter 2, Section 2.2.1 for further discussion).

Despite its theoretical emphasis, the dissertation also provides novel contributions to experimental methodology for data acquisition. Specifically, I propose that parallel corpora can be used for *semi-automatic* analysis by (i) automatically aligning the translations, (ii) manually annotating the resulting alignments with a relatively theory-neutral scheme, and (iii) using detailed theoretical analysis to account for patterns found. Python 3 source code for replicating the automatic parts is available as open-source.[3]

[3] https://github.com/tombgro/translation-analysis

1.4 Experimental results

Of 45475 Finnish-English translation shifts (combined from both translation directions), 84.9% are covered by 19 syntactic points of variation. These are further allocable to five higher-level classes: (i) the presence/order of functional heads, (ii) morphological marking, (iii) movement/EPP, (iv) linearization, and (v) selectional constraints. In contrast, 12.7% of the shifts are lexical in nature, not following from generic (morpho)syntactic properties of Finnish and English. Together, syntactic, lexical, and orthographic shifts cover 98.9% of all translation shifts. Overall, while construction-specific information cannot be discarded, it can plausibly be accounted for via explicitly memorized exceptions to the default pattern of *compositional translation*, where the target expression's syntactic structure systematically depends on the source expression's syntactic structure. In addition to explaining observed translation shifts, I provide a pipeline for predicting such compositional translation between Finnish and English, given independently motivated syntactic analyses of both languages.

1.5 Overview of the dissertation

Chapter 2 reviews background literature and general considerations of both theoretical and experimental methodology. Chapter 3 covers the linguistic framework adopted, and outlines the PF-based account of language differentiation. Chapter 4 discusses conceptual cognition and the syntax-semantics interface from the conjunctivist perspective. Using these frameworks on I-language and semantic interpretation, Chapter 5 introduces the analysis of translation as immediate entailment, and discusses how the translation of complex phrases can be determined by the translations of their constituents. Chapter 6 describes the experimental methodology in technical detail, reports quantitative results on Finnish-English translation shifts, and analyzes these with the theoretical tools laid out in preceding chapters. It also presents a generic pipeline for predicting syntactic properties of target expressions based on the syntactic properties of source expressions, and applies this to Finnish-English translation (in both directions). Chapter 7 summarizes the main contents of the dissertation and suggests prospects for future work.

Chapter 2

Natural translation competence in I-language

This chapter delineates the research topic (Section 2.1), discusses methodological considerations for the theoretical domain as well as empirical data-analysis (Section 2.2), and reviews prior research on translation from related perspectives (Section 2.3).

2.1 Natural translation competence

The term *translation competence* is commonly used of the ability to provide sufficiently good translations for e.g. professional, artistic, or academic purposes (Pym 2003, Malmkjaer 2009). This conception is inherently *normative*, and thus dependent on some external authoritative assessment. In contrast, in this dissertation I am concerned with translation competence in a *cognitive* sense: the mental architecture underlying the capacity to translate.

Chomsky (1965) drew a distinction between cognitive *competence* and its behavioral manifestation, *performance*. While this separation has often been treated as controversial (e.g. Newmeyer 1983, Bybee and McClelland 2005, Evans and Green 2006, Karlsson 2007), there is a basic sense in which it can be formulated in a fairly unproblematic way. Competence assimilates to a system's structural architecture (its "design"), and performance to its behavior in terms of input-output relations.[1] How our brains are neurally wired, which modules

[1]For an analogy, suppose a set of water pipes connected to each other. How the pipes are connected constitutes the "competence" of the system, and where the water flows when poured into a particular pipe constitutes its "performance" – possibly also influenced by factors outside the connectivity alone (e.g. water pressure).

(if any) can be distinguished, which computational units and relations should be recognized etc. are questions of competence. Performance corresponds to the functioning of the system determined by its competence, the input, and influence from other systems it is connected to.

While competence-based analysis can (sometimes) allow separating the cognitive system into different parts, performance always concerns the system as a whole. Therefore, performance can only give indirect evidence of the underlying competence. It does not function as a special "voice of competence" that sidesteps other aspects of cognition – nor is this a prerequisite for studying competence (*pace* Devitt 2006, 2013). Rather, performance can be used as data to evaluate hypotheses about certain aspects of competence, because those aspects are likely prevalent in the causal etiology of the performance (Slezak 2007, Ludlow 2011, Smith 2013, Maynes and Gross 2013, Rey 2020, Gross 2021).

Harris (1976) suggested that an ability to translate automatically arises from *bilingual competence*. He separated this *natural translation* capacity from skills based on further training. Its existence does not imply that all bilinguals translate alike (c.f. Valdés 2003, Malmkjaer 2009). Instead, the hypothesis maintains that a significant level of translation competence is already available to bilingual speakers by virtue of their competence in two languages. It has subsequently received confirmation from multiple findings of notable translational abilities among adolescent bilinguals (Shannon 1987, Malakoff and Hakuta 1991, Malakoff 1992, Valdés 2003, Dorner et al. 2008, Daniel and Pacheco 2016).

Initially, the notion of natural translation could be criticized for downplaying *metalinguistic* knowledge. Metalinguistic conceptions of translation competence have been abundant, especially in the field of translation studies. Wilss (1982) argued that translation is made possible by a "supercompetence", which provides pragmatic and discourse-related information about the source and target languages. Bell (1991) includes contrastive knowledge concerning the differences between the source and target language into his cognitive model of translation. Gutt (1991) subsumes translation entirely under a general analysis of (meta)communicative cognition. Malakoff (1992) treats spontaneous translation competence in bilinguals as an inherently metalinguistic skill. Kiraly's (1995) model of translation competence contains numerous skills characterizable as metalinguistic, including knowledge of the translation itself. Toury (1995) argues that translation competence requires so-called *transfer competence*, which concerns how the source and target language relate to each other depending on various contextual and communicative factors.

However, the contrast between natural translation and metalinguistic conceptions should not be exaggerated. For example, Toury (1986) makes a distinction between translation competence and *interlingual competence*, characterizing the latter as “the ability to establish similarities and differences (...) between items, structures and rules pertinent to those languages that a bilingual speaker has at his disposal” (Toury 1986: 85). This is very similar to Harris’ (1976) natural translation.[2] Hence, Toury actually seems to accept the existence of natural translation while denying that it suffices to account for translation competence *proper*, which requires additional metalinguistic competence. The contrast is thus largely terminological.

Harris and Sherwood (1978) propose a list of requirements for natural translation, reproduced below as (1):

(1) a. the pleasure that young children derive from translating
   b. a bilingual mental lexicon
   c. a language-independent semantic store
   d. an ability to conserve meaning across languages

(Harris and Sherwood 1978: 168–169; also reprinted in Malmkjaer 2009: 130)

The first component (1a) is fully performance-related and hence irrelevant for natural translation *competence* (see above). The third component (1c) is arguably redundant, given (1d).[3] This leaves (1b) and (1d): a bilingual mental lexicon and some way to conserve meaning between languages. For Harris and Sherwood (1978), the bilingual lexicon component not only contains lexical entries for both the source and the target language, but also provides *links* between such entries, effectively behaving as a mental dictionary.

[2]Adopting Toury’s terminology, a central thesis defended in this dissertation is that translation arises from *interlingual inferential competence* (Chapter 5). The relation between natural and explicitly learned translation is also related to the distinction between *vertical* and *horizontal* translation. Vertical translation involves interpreting the source expression and producing the target expression based on this, while horizontal translation functions via direct replacement of lexical or grammatical structures (De Groot 1997). Christoffels and de Groot (2005: 459) call vertical translation *meaning-based*, and horizontal translation *transcoding*. Metalinguistic competence has been argued to be necessary for horizontal translation, since it requires the explicit memorization of inter-lingual mappings between constructions (Paradis 1994: 329, Schaffer and Carl 2015: 24). Paradis (1994) argues that translation-specific (and thus metalinguistic) rules underlie translation competence that surpasses the conceptual comparison involved in vertical translation.

[3]As discussed in Chapter 4, the language-independence of the conceptual *system* is compatible with the language-specificty of *concepts* within this system.

However, a theoretical problem quickly arises if natural translation is to be based on memorized bilingual dictionaries. Suppose that such a dictionary contains a source-target pair. It can now be asked *how* the speaker has acquired this pair. The dictionary itself does not bring it into existence, but merely functions as a long-term memory storage for pairs fixed by some *other* mechanism. The most viable candicate for this mechanism would be some semantic/conceptual relation between the source and target. But – given that this relation *already* links them – it becomes unclear why a separate mental dictionary would be needed in addition.

The stipulation of translation-specific cognitive systems (such as a mental dictionary) can be contrasted with a *minimal hypothesis* concerning natural translation competence. This maintains that only two prerequisites are needed: (i) bilingual competence, and (ii) a conceptual system that allows linking the conceptual interpretations of expressions between different languages. This dissertation provides a novel account of natural translation competence that is in line with the minimal hypothesis.

2.2 Theoretical background and empirical methodology

I will now discuss the type of theoretical analysis conducted in this dissertation (Sections 2.2.1–2.2.2), as well as methodological considerations on data acquisition (Section 2.2.3).

2.2.1 The I-language perspective

As a reaction to the radical empiricism of the structuralist-behaviorist school of thought (Bloomfield 1933, Harris 1951, Skinner 1957, Jakobson 1971a,b), generative linguistics drew attention away from "directly perceivable" phenomena like sounds and situational triggers for speech,[4] and toward the cognitive competence required for understanding and producing language (Chomsky 1959, 1965, 1975). Using terms introduced later by Chomsky (1986b), generative linguistics studies *I-language*, where "I" stands for *internal*, *individual*, and *intensional*. This can be differentiated from *E-language*, where "E" stands for *external*, *environmental* and *extensional*. I-language is internal to each individual speaker's cognitive system, and specified in intension rather than extension: the research concerns the procedures by which linguistic

[4]The assumption that even sounds or other external objects are perceived "directly" is of course contestable; but it can at least be granted that if *anything* in linguistic data is perceived directly in some sense, those are better candidates than e.g. syntax trees or abstract semantic structures.

performance can be produced rather than the performance itself. This section clarifies how the I-language perspective relates to other conceptions of language.

Initially, I-language seems to oppose the viewpoint that language is essentially *normative*, and hence cannot be located to the cognitive systems of individual speakers. As Wittgenstein (1953) maintained, normativity requires the possibility of evaluating the process from an *external* point of view. Hence a speaker alone cannot determine the correctness of her language use. Kaplan (1989) favourably described a related perspective which he called "consumerism":

> "Words come to us prepackaged with a semantic value. If we are to use those words, the words we have received, the words of our linguistic community, then we must defer to their meaning."
> (Kaplan 1989: 602)

The consumerist view treats grammatical and semantic properties as pertaining to expressions that exist outside of invididual speakers and determine the correctness of their linguistic behavior via communal practices related to proper use. If this is considered to be a necessary property of anything properly called "language", any "internal language" becomes conceptually impossible (c.f. Itkonen 1978, 1983). Similarly, Lewis (1970) maintained that theories which treat semantic interpretation as mapping linguistic structure to an internal conceptual representation are "at best a substitute for real semantics" (p. 18), where the latter maps expressions to the external world.[5]

As the sources cited above correctly state, the common-sense notion of "language" is far more similar to E-language than I-language. Therefore, a theory of I-language could never achieve a *conceptual analysis* – let alone a definition – of the word "language", which would appropriately characterize its everyday use.[6] Instead, I-language has a (limited but crucial) role in accounting for *why* those phenomena we would generally call "linguistic" function the way they do. The link between language and I-language is not conceptual but *explanatory*.

[5]Lewis (1970) was specifically targeting Katz and Fodor (1963). His advocacy of truth-conditional semantics diverges in crucial ways from the (late) Wittgensteinian approach that eschews referential and truth-functional frameworks in favor of a use-based account of meaning. Nevertheless, they share the "consumerist" viewpoint, albeit in different ways. See Chapter 4 (Section 4.1) for related discussion concerning concepts.

[6]Indeed, if the atomistic considerations reviewed in Chapter 4 are correct, there is no definition of "language" at all, since conceptual identities are not fixed via relations between concepts. However, the present discussion does not depend on this.

By the same token, the notion of *rule* has (at least) two major uses in linguistic theory. One common interpretation is that rules are normative and hence can be *broken*. This leads to much-discussed philosophical dilemmas related to deciding which rule a speaker is following, given only limited evidence that is ambiguous between many options (Kripke 1982). Another use of the word "rule" does not treat it as a normative criterion for behavior, but instead a description of the *computational mechanism* a system implements. This is the sense in which a computer "follows rules" when executing a program. It is also the sense in which grammatical rules are treated within the I-language perspective.[7]

There is thus no contradiction in accepting that the words "language" and "rule" have normative (and hence non-individualist) interpretations both in ordinary use and for many theoretical purposes, without denying the reality and explanatory relevance of I-language.[8] This carries over to translation as well: the I-language perspective is not going to yield a conceptual analysis of the term "translation"; instead, it can help explain how translation can exist in the first place and why it manifests in the way observable from empirical data.

My approach to I-language is inclusive of socio-normative viewpoints alongside it, standing in contrast to conceptions such as Glackin's (2018), as quoted below:

> "(...) there is no such thing as linguistic society as far as Chomskyans are concerned, just individual men and women. And it follows on this view that linguistics is not normative; there are no external public standards against which a mature speaker may be judged to have erred in her speech."
> (Glackin 2018: 163)

Glackin conflates two different aspects of the I-language perspective: (i) what is focused on in research, and (ii) what is claimed (not) to exist. While he correctly notes that Chomskyan linguistics is not normative, he infers from it an eliminative stance on the existence of

[7]There is also indeterminacy between I-language rules and the limited evidence available during language acquisition – the so-called *poverty of stimulus* (Chomsky 1959, 1986b, Laurence and Margolis 2001, Berwick et al. 2011) – but this does not result in philosophical problems akin to those discussed by Kripke (1982). In generative linguistics, the problem of language acquisition is not how to determine grammatical rules from empirical evidence alone, but rather why a certain cognitive configuration (I-language) is reached rather than some other, given both the (limited) evidence and the initial state of the cognitive architecture.

[8]Admittedly, Chomsky's own assesments of E-language as an object of study have sometimes been dismissive (especially in Chomsky 2000b). However, this does not characterize the I-language perspective as a whole (for further discussion, see e.g. Pateman 1987, Ludlow 2011, Rey 2020).

normativity. This is not necessary: I-language can be the focus of *some* studies while normative conceptions of language are manifestly important elsewhere, as in sociolinguistics (Labov 1972, 2001). Instead of pitting different frameworks against each other, it is vital to acknowledge the need for their constructive interaction.[9]

The I-language perspective unites most research in generative linguistics. However, some theorists have suggested alternative conceptions of the object of study, while maintaining an otherwise sympathetic view of generativism. Below, I briefly review three such contenders, and conclude that none of them provide a reason to abandon the I-language perspective.

Katz (1981) calls for a Platonist interpretation of linguistic structures, which treats them as abstract objects unrelated to human thought (see also Postal 2003, 2009). However, as Jackendoff (2002: 299) notes, Platonism does not provide an account of how language is *grasped* by the human mind. Hence, the task of understanding I-language remains essentially untouched even if Platonism was accepted. The problem is not unique to language: for example, Platonism about mathematics would not relieve cognitive science of the task of understanding mathematical cognition (e.g. Campbell and Epp 2005). Hence, the question of whether languages exist as abstract entities outside of I-language can be set aside for present purposes.

Devitt (2006) follows American structuralists like Bloomfield (1933) in suggesting a physicalist interpretation of linguistic properties being instantiated in mind-external objects. A major challenge for this account is that most properties relevant in generative research do not seem to be instantiated in such a way: linguistic features (e.g. *noun/verb*) or structural configurations (e.g. *c-command*; see Chapter 3, Section 3.1.2) are not definable as properties of linear patterns of sounds(/signs/graphemes). Rather, they are (hypothetical) properties of mind-internal computational units and their structural configurations (Slezak 2007, Smith 2006, 2013, Fitzgerald 2009, Collins 2014, Adger 2022). Outside of I-language (and a possible abstract realm set aside here; see above), these properties have no reality at all. The remaining options are thus either to discard them or to allocate them to cognition. Their explanatory value in linguistics (see Chapter 3) speaks in favor of the the latter – i.e. the I-language perspective.

Finally, Rey (2020) is sympathetic to the generative enterprise but disagrees with the idea that grammatical structures should be allocated to cognition (specifically targeting the interpretation of Collins 2014). Instead, he argues that linguistic entities are *fictitious intentional*

[9]For concrete proposals to increase the interaction between generative linguistics and sociolinguistics, see Adger and Smith (2005) and Adger (2006).

contents of cognitive states, similar to contents of "empty names" like *Sherlock Holmes*. This view is nuanced, and its detailed assesment would deserve more space than available here. One major issue is whether it is compatible with *derivational* operations like those used in Minimalist theory (see Chapter 3). Instead of simply assuming what Rey calls "standard linguistic entities" (e.g. words or phrases) as available representations, Minimalism focuses on operations responsible for their construction and interpretation at the phonological and conceptual interfaces. It is unclear how such operations could apply to fictitious intentional contents as such; rather, their causal efficacy to grammatical and interpretational operations ultimately needs to stem from their physical manifestation. Since fictitious entities have no physical manifestation, this again invites the I-language perspective.

This brief exposition obviously cannot resolve the numerous intricate debates mentioned. Nevertheless, I hope it has elucidated the I-language perspective by contrasting it with its main alternatives, and clarified that these perspectives do not need to stand in opposition. Understanding I-language is crucial for accounting for why human language exhibits the range of possible manifestations it can; but a proper explanation of linguistic phenomena requires collaboration between multiple fields and perspectives. I also briefly reviewed three alternative conceptions to the I-language perspective that have been provided by theorists sympathetic to the generative framework on the whole. Leaving their more elaborate examination for future work, I contend that the I-language perspective remains viable.

2.2.2 Computational cognitive science

This dissertation adopts a computational perspective on I-language and translation. The term "computational" has many uses both within and across different fields. Without attempting an exhaustive taxonomy, I distinguish between three salient notions. First, anything implemented on a computer can be considered computational. This is manifested in terms like *computational neuroscience* or *computational modelling*. However, it is *not* the sense I use the term "computational" in this dissertation.

The second use of "computational" is derived from Marr's (1982) division between three levels of explanation. Level 1 accounts for the functioning of a system on a high level: what tasks it achieves, and what purposes those tasks serve in the environment. Level 2 mathematically specifies the internal representations and operations needed for the system to complete those tasks. Level 3 describes the realization of these operations in the concrete physical system (such as the brain). Level 1 is typically called either *functional* or *computational*, Level 2 *algorithmic*, and Level 3 *implementational*.

The third notion stems from the analysis of computation as *symbol manipulation*, as formalized by Turing (1937) and subsequently elaborated by e.g. Newell and Simon (1976), Newell (1980), and Pylyshyn (1986). Symbolic computation involves transitions between *states* of a system based on *formal*[10] properties of symbols that the system *reads* and *writes*, according to some law-governed operation describable as a *rule*. A system is computational if it conducts such read-write operations. On the implementational level, this requires it to manifest some kind of a *memory-processor* distinction, where symbols are held in memory, and the processor enacts read-write operations to modify them (Gallistel and King 2009).[11]

In this dissertation, I use the term "computation(al)" in the *third* sense: operations are computational if they manipulate symbolic structures (held in memory); a system is computational if it implements computational operations; and an analysis of a system is computational if it describes the computation implemented by the system.

A terminological divergence arises when comparing computation as symbol manipulation to Marr's levels of analysis. Specifying computational units and operations is often closer to Marr's *algorithmic* Level 2 than the "computational" Level 1, which provides a high-level description of the system's function. In practice, these levels can often be mixed. In my terminology, both Level 1 and Level 2 explanations are computational when they concern computational systems.

Adopting a Marrian distinction between higher-level computational/algorithmic processes and their concrete implementation in a physical system can be interpreted in two ways, with different theoretical consequences. One possible interpretation is *methodological*: analyses conducted on higher levels of explanation are needed to further our understanding of the processes ultimately taking place at lower, implementational levels. This is compatible with a variety of views concerning the fundamental nature of minds or cognition, and is not dependent on the so-called *computational theory of mind (CTM)*.

[10]Formal properties are local and based on the "shape" of the units or structures, rather than their relations to other entities (see e.g. Newell 1980, Pylyshyn 1986, Fodor 1987).

[11]This characterization may initially seem circular, since "symbol", "memory", and "processor" are interdefined. However, even if some kind of circularity is involved here, it is not vicious, as it simply means that the components need to be *mutually defined* – i.e. specified by virtue of how they relate to each other in the whole computational system (c.f. Piccinini 2015: 128).

The CTM, in turn, goes further than mere computational analyses in *assimilating* minds or mental states to their computational aspects (Putnam 1967, Fodor 1975, Block 1979, Rey 1997). Various problems with the CTM have been discussed extensively in philosophical literature, including the semantic grounding of symbols (Searle 1980, Harnad 1990), multiple realizability (Putnam 1967, Polger and Shapiro 2016), the boundary between cognitive and non-cognitive systems (Putnam 1988, Searle 1990), and the limits of rule-based computation for "common sense" reasoning (Dreyfus 1972, Fodor 2000).

Non-computational views of cognition have also increased in prominence, culminating in the so-called "4E" approach standing for *embodied*, *embedded*, *enacted*, and *extended* (e.g. Rowlands 2010, Hutto and Myin 2013, Newen et al. 2018). A common line of thought in this framework is that many aspects of cognition could be accounted for without assuming computations over internal representations. Some go further in claiming that computational/representational explanations should be *completely* removed from cognitive science. For example, Hutto and Myin suggest to "abandon the information-processing and representationalist views of cognition" (Hutto and Myin 2018: 105; see also Carney 2020).

However, there is a major distinction between the claim that *not all* of cognition is computational and the claim that *none* of cognition is computational. Counterarguments to the CTM would only be problematic for computational cognitive science if they showed that cognition does not have *any* computational aspects. By the same token, computational cogitive science does not need to be dedicated to the CTM. All it requires is that computation is *sometimes involved* in cognition. In Chapter 3 I argue for a computational perspective on (I-)language, and in Chapter 4 I extend the analysis to certain aspects of conceptual structures and their interface with language. In doing so I provide a case in favour of computational processes being involved in *at least those* aspects of cognition. While this goes against the "4E" viewpoint that suggests to abandon computation in total, it does not require endorsing the CTM and retains agnosticism about non-computational approaches to many other aspects of cognition.

2.2.3 Data acquisition and hypothesis testing

As mentioned in Section 2.1, hypotheses about linguistic competence are typically tested indirectly via linguistic performance that is likely to be significantly influenced by the competence under investigation. The most common of such methods is the elicitation of *linguistic judgements*, which can in principle concern any aspect of language: phonology, morphology, syntax, semantics, pragmatics, discourse, etc. (Schütze 1996, Marantz 2005, Maynes and Gross 2013, Gross 2021). In order for hypotheses to be testable in this manner, they need to make sufficiently clear predictions about judgements. In addition, analyses can be evaluated on theory-internal criteria such as simplicity, unambiguity, and how well they fit with well-established results and hypotheses in other fields (such as cognitive science, psychology, neuroscience, computer science, or the philosophy of language).[12]

Linguists commonly elicit judgements from themselves or only a small group of informants, which has led to questioning their reliability as evidence (Schütze 1996, Edelman and Christiansen 2003, Wasow and Arnold 2005, Gibson et al. 2013). Author-judgements provided in prominent generative literature have been successfully replicated in multiple experiments on non-linguist informants (Sprouse and Almeida 2012, Sprouse et al. 2013, Mahowald et al. 2016), but some studies have also found discrepancies (Spencer 1973, Gordon and Hendrick 1997, Linzen and Oseki 2018, Juzek and Häussler 2020).

I consider judgements to be imperfect but nevertheless highly important among the possible sources of linguistic data. In particular, the presence of a datapoint in a corpus does not reveal its *interpretation* in either grammatical or semantic terms. Judgements are needed to assess this. For example, outside of using judgements, it would be impossible to discern whether the Agent argument of *walk* in (2a-d) is *John* or *Mary* (marked with co-indexing).

(2) a. John$_i$ saw Mary$_j$ walk$_j$ to the house
  b. John$_i$ saw Mary$_j$ walking$_{i/j}$ to the house
  c. Walking$_i$ to the house, John$_i$ saw Mary$_j$
  d. John$_i$ saw Mary$_j$ while walking$_i$ to the house

Merely the presence of the relevant sentences in a corpus would not reveal the information in question, and hence judgements are needed for acquiring it. While it is easy to agree with Juzek and Häussler's (2020) contention that "[the use of judgements] combined with quantitative methods results in even better data" (p. 142), refraining from using judgements altogether would effectively stifle the study of many crucial linguistic topics.

[12]Linguistic judgements should be distinguished from *introspection*, which aims at attaining information about mental processes via their direct reflection. Unlike introspection, judgements are only used for the *indirect* testing of hypotheses concerning the underlying cognitive competence, not as means to gain direct insight into the competence itself (Gross 2021).

I further propose that source-target translation pairs should be considered as linguistic judgements in a broad sense. Specifically, I define a *translation judgement* as following the general scheme (3), where S is a source expression and T a target expression:

(3) S translates to T

Translation judgements can further be systematically connected to actually produced translations by the following general assumption: if a speaker produces the target expression T as a translation for the source expression S, then (*ceteris paribus*) she judges T to be a translation of S. Consequently, a collection of translations also constitutes a collection of recorded translation judgements. Such collections are called *parallel corpora*. While they have been applied in contrastive linguistics (Ebeling 1998, Johansson 2003, Barkow 2008, Doval and Nieto (ed.) 2019), in generative research they have so far remained practically unused.

The (re-)interpretation of parallel corpora as collections of translation judgements grounds the experimental methodology applied in Chapter 6, where both qualitative and quantitative information is extracted from Finnish-English parallel corpora via a combination of automatic and manual analysis. In contrast to standard data-driven methodologies, the purpose there is not to obtain theoretical generalizations from data alone, but rather to use these significant resources for extending the empirical range of theory-driven linguistic analysis. A further benefit of this method is that it allows minimizing author-provided judgements, relying instead on independently produced translation judgements recorded in the corpus. It is thus one way to extend the range of data acquisition methods within theoretical linguistics – as recommended by e.g. Juzek and Häussler (2020) – without shunning the use of judgements as such.

2.3 Review of prior work

The study of translation has undergone important changes during the last decades. Traditional linguistic approaches aimed at finding maximally equivalent grammatical structures for corresponding semantic interpretations (Jakobson 1959/2004, Catford 1965, Nida 1964, 1975). This was challenged by the subsequent "cultural turn" in translation studies, which shifted the field away from linguistic theory and closer to the social sciences (Steiner 1975, Bassnett and Lefevere 1990). More recently, academic interest in the cognitive basis of translating has increased, which has made more room for individual psychology. Sections 2.3.1–2.3.7 briefly survey prior work, with a specific focus on linguistic and cognitive approaches.

2.3.1 Early linguistic views: Jakobson and Catford

Jakobson (1959/2004) is a seminal paper that lays out a linguistic approach to translation following the structuralist program initiated by de Saussure (1916). Jakobson considers *equivalence* to be the central challenge of translation, given that languages use different means to "carve up" semantic space. Nevertheless, he maintains that equivalence is attainable in principle: each language has the means to express any meaning, even if some languages mandate expressing contents that others leave indetermined (see also Chapter 5, Section 5.1.1).

Catford (1965) adopts a functional linguistic framework after Halliday (1961) and Firth (1964), and distinguishes between two variants of equivalence. *Formal correspondence* is based on the target expression occupying a role in the target language that is maximally similar to the role that the source expression occupies in the source language. *Textual equivalence* is a match between the source and target expression in a particular context. The divergence of these can result in *translation shifts*, where the target language grammar differs from the source language grammar for achieving better translation quality.

The linguistic theories used by Jakobson (1959/2004) and Catford (1965) are non-cognitive, instead focusing on language as a communicative system in which individual speakers participate. While this approach can be fruitful for many purposes, it does not directly transfer to an account of translation from the I-language perspective (see Section 2.2.1). Hence, the relevance of these classical linguistic works on translation is limited for the purposes of this dissertation, despite their undeniable historical importance.

2.3.2 Transformational grammar and "deep structure"

Probably the best-known formal linguistic model of translation is found in the work of Nida (1964, 1975), which builds on early transformational grammar (Chomsky 1965) and the decompositional semantics of Katz and Fodor (1963). For Nida, translation takes place on the level of *kernel sentences*, which he defines as simple sentences the *surface structure* of which is maximally close to their *deep structure* (following Chomsky).

Nida's translation pipeline can be summarized via three steps: (1) deriving kernel sentences ("kernels" for short) from the original source expression via syntactic analysis; (2) translating the source kernels into equivalent target language kernels; and (3) expressing the target kernels' semantic content by equivalent but more pragmatically appropriate target language sentences. To maintain equivalence across translation between the source and target kernels, Nida suggested using the semantic system introduced by Katz and Fodor (1963), comprised of entries that define words by more basic concepts assumed to be available to the speaker (presumably innately). Additionally, Katz and Fodor's system specifies combinatorial operations for obtaining the meanings of complex syntactic phrases based on their constituents.

Nida also introduced the notions of *formal* and *dynamic equivalence*. Formal equivalence is determined as specified above, whereas dynamic equivalence concerns the effect of the target expression on the reader, and cannot be produced by rules in a similar deterministic manner as formal equivalence. Furthermore, Nida maintained that dynamic equivalence is more important than formal equivalence, and should take precedence if these are in conflict. This sometimes speaks in favour of "liberal" translations that steer away from maintaining literal meanings when these contrast with capturing the relevant pragmatic connotations, which can be e.g. emotional, cultural, religious etc.[13]

To properly understand Nida's perspective, the notion of "deep structure" requires further explanation. This is especially relevant in light of the wide variety of conceptions found in the translation studies literature, as shown by the following example quotes.

> "'Deep structures' are those innate components of the human mind that enable it to carry out 'certain formal kinds of operations on strings'".
> (Steiner 1975: 101)

> "In this [Chomskyan] view translation is a 'recoding' or change of surface structure in representation of the – non-linguistic and ultimately universal – deep structure underlying it. Taken to its extreme, this principle means that everything is translatable."
> (Snell-Hornby 1988: 41)

> "After Structural Linguistics comes Generative Lingustics in search of deep structures and language universals that would correspond to an innate competence modulated by the acquisition of an historical language. For a long time generativists thought they could base the construction of a translation system on these deep structures"
> (Lederer 1994: 89)

[13] In later work, Nida further emphasized the importance of the whole target culture on dynamic equivalence, preferring the term *functional equivalence* (DeWaard and Nida 1986).

As the quotes illustrate, deep structure has alternatively been equivocated with the underlying mechanisms of linguistic cognition, abstract linguistic universals, or language-independent conceptual structures. However, *none* of these is the conception actually used in transformational grammar, where deep structure was a *stage of the syntactic derivation*.

In Chomsky (1965), an expression is first built by *phrase-structure rules*, after which *movements* displace some elements to other positions. The pre-movement stage was called *deep structure*, and the post-movement stage *surface structure*. Later, in the *Government & Binding (G&B)* framework (Chomsky 1981, 1982, 1986a, Haegemann 1994), deep structure was replaced with *D-structure*, which was no longer the sole locus of semantic interpretation. Instead, interpretation was located to a post-movement stage of derivation titled *Logical Form* (LF). Later still, movement has been reformulated again within the Minimalist framework, resulting in D-structure no longer constituting a separate part of the syntactic derivation at all (Chomsky 1995a, Hornstein and Grohmann 2006, Boeckx 2006).[14]

Hence, transformational grammar's concept of deep structure was a theory-internal technical device that was first modified *not* to be the sole locus of semantic interpretation (in G&B), and subsequently removed in total (in Minimalism). This brings to question the idea that generative accounts of translation would require the assimilation of the source and target language in deep structure (*contra* e.g. Snell-Hornby 1988, Lederer 1994, Martín and López 2018): if there is no deep structure at all, this would obviously be nonsensical.

On the other hand, certain early approaches in *contrastive analysis* were motivated by transformational grammar and expressed sympathy for deep structure assimilation. For example, Krzeszowski (1971) explicitly states that the equivalence between constructions across languages should be based on their deep structures being identical. Similar ideas motivated contrastive research between the 1960s and 1980s (Dingwall 1964, Marton 1968, DiPietro 1971, Markkanen 1979, Zabrocki 1981).

[14]The original deep structure analysis makes false predictions for some movements, which have semantic consequences. For example, the passive *Someone was seen by everyone* takes a wide scope for *someone* unlike the active *Everyone saw someone*, indicating that the movement of *someone* to the grammatical subject position influences semantic interpretation. Uriagereka (2008) argues that something like the G&B-era D-structure should still be retained even in Minimalist theory. The tripartite division of syntax into different domains – adopted in Chapter 3 (Section 3.1.7) – also allows a partial reformulation of this idea, since argument relations are defined in a lower domain while movements target higher domains. However, these considerations do not challenge the fact that "deep structure" as the *sole determinant* of semantic interpretation is not part of current generative theory.

However, the use of "deep structure" in contrastive analysis differed crucially from the Chomskyan notion. It typically relied on an alternative conception based on *Case grammar* (Fillmore 1968) and *generative semantics* (Katz and Postal 1964, Lakoff 1971). These analyses assimilated deep structure to semantic(/conceptual) structure, and thus stood in opposition to Chomskyan *interpretative semantics*, where formal grammatical representations are "read" by a separate conceptual system. Instead, generative semantics attempted to derive the surface structure from the semantic structure via transformations (Harris 1995).

Case grammar and generative semantics motivated the treatment of deep structure as an appropriate *tertium comparationis* for contrastive analysis (James 1980: 171). Literature in this field explicitly drew a sharp distinction between Chomskyan deep structure and the semantic alternative, favouring the latter (DiPietro 1971, Krzeszowski 1981, Lipińskal 1981, Zabrocki 1981). To quote directly from Krzeszowski:

> "Deep structure as conceived of by me was not to be identitied with Chomsky-type structure defined in Chomsky 1965. Following Lakoff's line of argumentation (Lakoff 1968), I envisaged deep structure as a more abstract level of representation in a semantically based grammar where 'deep structure' would be synonymous with semantic representation."
> (Krzeszowski 1981: 106–107)

Ideas stemming from generative semantics have since deepened their contrast with generative syntax, culminating in the anti-formalist framework of *cognitive grammar* (Langacker 1987, Lakoff 1987, Evans and Green 2006). Somewhat ironically, then, the notion of translation via deep structure convergence has been contrary to the Chomskyan conception of syntax from the beginning. As Genzler (2001: 50) notes, Chomsky starkly contrasted this view, explicitly warning *against* equivocating deep structure convergence with translatability:

> "The existence of deep-seated formal universals (...) does not imply that there is any point by point correspondence between particular languages. It does not, for example, imply that there must be some reasonable procedure for translating between languages."
> (Chomsky 1965: 30, reprinted in Genzler 2001: 50)

Unlike contrastive analysis influenced by generative semantics and Case grammar, Nida followed the Chomskyan, *syntactic* conception of deep structure: his kernel sentences are not deep structures but simple sentences that are *maximally close to deep structure in surface structure*. Formal equivalence can be achieved between kernel sentences, but this does not mean that the kernels themselves constituted "a language-independent interlingual representation, common to all languages" (Carl and Schaffer 2017: 52). This conception would be closer to generative semantics, *opposing* the Chomskyan conception.

Even after more than half a century, Nida's analysis remains the most known and influential model of translation from a generative perspective. Since it is not dependent on fully assimilating the source and target expression in deep structure, it is worth investigating which aspects of it could be worth retaining within a linguistic framework that discards deep structure.

2.3.3 Translation as decision making: Levý

A significant impetus toward the cognitive study of translation came from Levý (1967), who argued that translation should be modelled as a *decision process* formalizable within *game theory* (von Neumann and Morgenstern 1953). For Levý, an act of translation consists of a sequence of choices, each of which affects possible future choices. The source expression gives *definitional instructions* for the target expression, which are satisfied by a number of candidates. All candidates satisfying the instruction form a *paradigm*. If the paradigm contains more than one candidate, a subset of it is chosen by a further *selectional instruction*, which is determined by the context, the translator's beliefs, stylistic considerations, etc. Selectional instructions are invoked until the paradigm has only one member, which is the final target.

The translator may also add something to the target that is not present in the source, because the source has a broader meaning not available in the target language. Conversely, if the source is more specific than any available target language expression, the target will have a broader interpretation. Levý calls these *divergent* and *convergent* translation, respectively. He provides an inter-lingual example of translating between the simplified "Basic English" verb *make* and its possible "Standard English" correspondents. If *make* is the source, its Standard English targets diverge into many candidates: *produce*, *manufacture*, *constitute* etc. Conversely, any of these would converge to *make* in Basic English.

The analysis developed in this dissertation also builds on the idea of translation as an inferential process, and the distinction between divergent and convergent translation plays an important role (see Chapter 5, Section 5.2). It thus continues Levý's project in a broad sense; based on linguistics and computational cognitive science instead of of game theory.

2.3.4 Transformation as information processing: Bell

Bell (1991) defends an explanatory approach to translation, as opposed to what he sees as merely descriptive or taxonomic trends in prior literature. Within an information-processing paradigm familiar from classical cognitive psychology (Neisser 1967, Fodor 1983, Baddeley 1986, Pylyshyn 1986), he models translation as a cognitive process with multiple stages taking place within and between dedicated modules. These include operations specific for reading (such as visual recognition), grammatical parsing, semantic interpretation, relating contrastive knowledge about the source and target languages, and discourse-related pragmatic considerations. Translation involves semantic comparison, but this is only discussed on a very high level, as illustrated by the quote below:

> "The TL [target language] syntactic processor accepts the input from the semantic stage, scans its FLS [frequent lexis store] for suitable lexical items and checks in the FSS [frequent structure store] for an appropriate clause-type which will represent the proposition. If there is no available clause structure in the FSS to convey the particular meanings, the proposition is passed through to the parser (which is now functioning as a syntactic synthesizer) and, finally, the writing system is activated to realize the clause as a string of symbols which constitute the target language text."
> (Bell 1991: 60)

Bell assumes that the "semantic stage" output from processing the source language can function as direct input for the target language parser, and that "suitable lexical items" can be found in the target lexicon. Ultimately, he relies on assuming "a completely language-free semantic representation" (Bell 1991: 54). This is hardly satisfactory as a starting point, as it simply sidesteps the most central and challenging aspect of translation: finding appropriate semantic correlates between the source and target language.

Bell's model could thus be considered more of a descriptive clarification of the aspects of cognition that would *need* to be accounted by a sufficient model of the translation process. While this is certainly useful, it arguably falls short of the *explanatory* task which Bell explicitly undertakes. Despite these limitations, the book remains important as the first major attempt to provide a comprehensive account of the operations underlying translation within the modular information-processing framework of classical cognitive psychology.

2.3.5 Translation as communication: Gutt

Gutt (1991) also takes a cognitive perspective, but argues that translation theory should be subsumed by the more general account of communication adopted in *Relevance Theory (RT)* (Sperber and Wilson 1986). RT provides a model of communication, where the hearer interprets communicative *cues* given by the speaker. Importantly, cues *underdetermine* the thoughts they can trigger in the hearer, and this indirect relation between cues and their (intended) interpretations grounds *linguistic pragmatics* (see e.g. Carston 2002, 2008). At the core of pragmatic inference is the *principle of relevance*, according to which the hearer will infer to the thought that they consider maximally relevant in the discourse (Grice 1975).

Gutt's main claim is that translation consists in *cross-linguistic communicative cues*, to be explained in the same way as other communicative cues in RT. Like Bell (1991), he relies on the assumption that semantic/conceptual content can be faithfully retained across the source and target expression. His account thus suffers from a similar problem as Bell's in simply stipulating a major component of the analysis – indeed, the most important one.

Another potential problem with Gutt's view is that it may yield translation untractable by scientific analysis, due to the multifaceted and highly context-dependent nature of communication. According to Chomsky (2000b), accounting for such matters results in *uninformative* theories, which is why they lie outside the proper domain of science:

> "The interpreter (...) includes everything that people are capable of doing, which is why it is not an object of empirical inquiry (...) if we begin with a demand for a theory of everything, we will find nothing"
> (Chomsky 2000b: 69–70)

Similar remarks are made by Fodor and Pylyshyn (2014: 76), who compare the question of "what is the 'right' translation of a certain text" to "which of two jokes is funnier" or "what, precisely, is the message transmitted in a certain communication"; each being "endlessly sensitive to contextual detail" and hence beyond the scope of scientific theory.

However, while such concerns should be taken seriously, I do not believe they invite a dismissal of topics like translation (or even communication) from scientific inquiry. Important generalizations have been uncovered about many complex and multifaceted phenomena that still turn out to have robust predictable properties, such as grammatical errors in spontaneous speech (Pfau 2009), historical language change (Roberts and Roussou 1999, Roberts 2007, van

Geldren 2011), or bilingual code switching (MacSwan 1999, Alexiadou et al. 2015, Grimstad et al. 2018, Alexiadou and Lohndal 2018). *Prima facie*, these phenomena are *holistic*: whether speakers e.g. make errors or engage in code switching is influenced by an open-ended set of factors extending beyond I-language. Nevertheless, their analysis has resulted in significant linguistic findings and the corroboration of certain hypotheses over others. There is no *a priori* reason why this could not be true of translation as well.[15]

2.3.6 Contemporary cognitive and linguistic approaches

Considerations of the cognitive processes underlying translation have become markedly more prominent in translation studies during the last two decades (Shreve and Angelone 2010, Risku 2012, Ferreira et al. 2015, Alves 2015). This development is especially manifested in *process-oriented* translation studies, which aim to uncover the mental operations involved in translation tasks measured in real-time. Experiments have involved behavioral and physiological methods such as thinking aloud, keystroke logging, eye-movement tracking, or brain-imaging (Jääskeläinen 2011, Albir et al. 2015, Garcia et al. 2016).

Along with the increased focus on cognitive processes, linguistics has been partly reintroduced to translation studies. The framework of *construction grammar* (Croft 2001, Tomasello 2003, Goldberg 2006) has been especially prevalent here (Tabakowska 1993, Shreve 1997, Halverson 2009, Szymánska 2011, Rojo and Ibarretxe-Antunano (ed.) 2013, Serbina 2015). In contrast, while some literature has expressed a sympathetic perspective toward generative linguistics (e.g. Malmkjaer 2008, 2009), it has mostly remained absent.

The basic thesis adopted by most constructionist approaches is that there are no syntactic structures like those postulated in generativism.[16] Instead, they maintain that language is processed via *direct links* between semantic/conceptual and articulatory "chunks" of interpreta-

[15] In fact, similar considerations seem applicable to Chomsky's own work on language, which has provided more technical conceptions as replacements for common-sense notions for certain scientific purposes. As discussed in Section 2.2.1, the pre-theoretical term "language" suffers from the same kinds of problems as e.g. "the interpreter", which Chomsky examines in the quote above. Yet, this has not prevented the development of linguistic theory; rather, it requires recognizing the complexities involved in relating theoretical vocabulary to common-sense vocabulary (see also Chomsky 1986a, 2000b, Collins 2008).

[16] An exception to this generalization is the "parallel architecture" model (Jackendoff 2002, 2010, Culicover and Jackendoff 2005), which is constructionist in the sense of relying on memorized constructions, but formalist in the sense that these include abstract (morpho)syntactic features in addition to semantic and phonological ones.

tion. This view is commonly combined with a *sensory-motor* approach to conceptual content, which serves as the basis of *cognitive grammar* (Langacker 1987, Lakoff 1987, Evans and Green 2006). The resulting view of translation would thus be based on proximity or overlap in the sensory-motor semantic space, in line with what Fodor and Lepore (1992) call *state-space semantics* (see e.g. Churchland 1998, Gärdenfors 2000, 2014).

Chapter 4 argues against assimilating concepts to descriptive information of any kind (either sensory-motor or abstract), and Chapter 5 presents a detailed case against translation being based on conceptual overlap. I do not directly argue against construction grammar in this dissertation, but rather present an alternative that utilizes formal syntactic objects as central parts of the theory. Conversely, the applicability of this approach to empirical data with a high explanatory coverage (as documented in Chapter 6) constitutes a case in favor of the syntactic structures posited. Showing these to be disposable would thus involve establishing an alternative that manifests similar (or better) explanatory power without using them. I do not find such an alternative to be forthcoming; otherwise I would have discarded formal syntax myself. That being said, increasing constructive interaction between generative and constructionist viewpoints would be critical in future work.

2.3.7 Machine translation

As this dissertation concerns translation as part of bilingual competence in human cognition, a thorough review of machine translation (MT) would not be pertinent here.[17] Instead, I briefly discuss Dorr (1993)'s system as an explicit attempt to ground translation on generative linguistic theory. In addition, I argue that present-day techniques in MT have little to offer for understanding natural translation competence.

Dorr (1993) constructs an *interlingual* MT system, where the source language is mapped to a language-neutral semantic representation, from which the target language is generated. She bases the interlingual format on Jackendoff's (1983, 1990) *lexical conceptual structure*, and the language-specific generation on the *Principles and Parameters* approach in generative linguistics – specifically, the G&B-era (Chomsky 1981, 1982, 1986a,b, Haegemann 1994). Here, all languages are taken to follow the same universal principles with some options left

[17]For surveys of the history and methods of MT, see e.g. Hutchins (2010) and Dabre et al. (2020).

open, and “parameters” are language-specific choices for such cases.[18] Dorr builds on this idea, where the interlingual lexical conceptual structure is free from any parametric information (being non-syntactic), and semantic representations can therefore be expressed in all languages irrespective of their parameters. No translation rules are specific to any language pair; instead, the rules map each language to the interlingual format and back.

Without going further into the technical details of Dorr (1993), what is relevant for present purposes is that – like e.g. Bell (1991) – it is built around the prevalent but problematic idea of translation as “re-coding” universal language-neutral semantic contents. As discussed in Section 2.3.2, this has often been assumed to be the only available option for generative linguistics, given its theoretical focus on universal aspects of linguistic competence. Indeed, Dorr’s use of lexical conceptual structures as an interlingua resembles the (mistaken) interpretation of Chomsky’s “deep structure” or Nida’s “kernel sentences” as language-neutral representations (Snell-Hornby 1988, Lederer 1994, Carl and Schaffer 2017). It thus effectively discards *a priori* the possibility that conceptual structures might be at least partly language-specific.

In contrast, one of my main aims in this dissertation is to allow concepts to vary across languages without threatening the possibility of translation. I further maintain that this is fully compatible with the overall universalist foundation of generative linguistics. The key is to deny that translation requires “re-coding” the conceptual information of the source expression, and instead analyze it as an inferential relation (see Chapter 5). Hence, despite initial surface-level similarities between my approach and interlingual rule-based MT systems such as Dorr (1993), both their goals and theoretical claims differ markedly.

Contemporary MT is almost invariably based on *supervised machine learning*, where the system is trained to generate target expressions from source expressions (e.g. Bahdanau et al. 2015, Wu et al. 2016, Johnson et al. 2017, Vaswani et al. 2017). Practically all state-of-the-art systems are *deep neural networks (DNNs)* trained via the *backpropagation* algorithm for minimizing error between the target and the generated prediction (Rumelhart et al. 1986). The models are given a large number of source-target pairs, and are trained to find general patterns for predicting the most likely translations of arbitrary source language expressions.

In contrast, natural translation competence is not based on statistical generalizations made from vast numbers of example translations. Instead, it arises *automatically* as a product of

[18]For example, Spanish allows null subjects while English does not, and hence has a different value for the so-called *pro-drop* parameter. See Chapter 3 (Section 3.2) for further discussion.

bilingual competence (see Section 2.1). The fundamental question is thus different than in standard MT: natural translation competence needs to be explained *without* assuming the backbone of supervised learning, i.e. explicitly given source-target examples. Therefore, while furthering the interaction between MT and the theoretical study of translation is important in principle, no direct conclusions can at present be drawn from the former to the latter.[19]

2.4 Summary

This chapter has reviewed the research topic of the dissertation (Section 2.1), methodological issues concerning both theory construction and empirical data-analysis (Section 2.2), as well as prior work on translation within related frameworks (Section 2.3). The topic of study is *natural translation* (Harris 1976) from the perspective of the underlying cognitive *competence*. The focus is on *I-language* (Chomsky 1986b), analyzed from a *computational* standpoint.

I defended the use of linguistic judgements as one (but not the only) important source of data for hypothesis evaluation, due to their unique capacities for providing information not available elsewhere. Furthermore, I proposed that translation judgements can be considered as a subtype of linguistic judgements, which allows the utilization of parallel corpora as large repositories of recorded judgements. This idea grounds the experimental methodology applied to translation shifts on Finnish-English data in Chapter 6.

The analysis of translation proposed in this dissertation bears partial similarity to Nida (1964, 1975) in employing generative linguistics, Levý (1967) in treating translation as an inferential relation, Bell (1991) in locating the topic of study as part of cognitive science, and Gutt (1991) in its proximity to Relevance Theory and rejecting the need for translation-specific cognitive processes. However, in contrast to most prior approaches, I do not rely on the *a priori* assumption that conceptual interpretations are always uniform across languages.

[19] This is not to say that contemporary work in natural language processing has no possible theoretical ramifications. For example, Google's machine translation system has succeeded in *zero-shot* translation between language pairs it had not been explicitly trained on (Johnson et al. 2017), and multilingual models have displayed spontaneous convergence between languages (Pires et al. 2019, Chi et al. 2020). As of yet, the theoretical implications of such findings remain unclear and in need of further investigation. Another recent research domain is *unsupervised MT*, which uses monolingual training datasets from two languages instead of explicit source-target pairs (Conneau et al. 2017, Lample et al. 2017, 2018, Artetxe et al. 2018a,b, Conneau and Lample 2019). At least *prima facie*, this resembles natural translation more than the supervised setting. However, the techniques proposed have so far not been motivated by cognitive considerations.

Chapter 3

Linguistic framework

This chapter outlines the linguistic framework adopted. The approach is mostly in line with *Distributed Morphology (DM)* (Halle and Marantz 1993, 1994, Harley and Noyer 1999, Embick and Noyer 2007, Bobaljik 2015, Embick 2015), but involves some additions. In particular, I incorporate the idea that syntactic phrases are divisible into hierarchically ordered *domains* that serve different grammatical functions (Grohmann 2003, 2011, van Gelderen 2013, Ramchand and Svenonius 2014, Wiltschko 2014). I then discuss how linguistic variation and bilingualism can be analyzed from this perspective. With respect to the latter, I propose that different "languages" within bilingual I-language should be reconstrued as groups of post-syntactic *PF-rules* that link the syntactic derivation to phonology.

Section 3.1 covers the general I-language architecture, Section 3.2 the loci of linguistic variation, and Section 3.3 the division between languages in bilingual cognition.

3.1 Architecture of I-language

I review the *Y-model* of the syntactic derivation (Section 3.1.1), the main syntactic operations (Sections 3.1.2–3.1.4), and types of syntactic heads: *roots* (Section 3.1.5) and *functional heads* (Section 3.1.6). These provide the basis for *extended projections*, further divided into three syntactic *domains* (Section 3.1.7). Finally, I discuss the *syntax-phonology interface*,[1] endorsing a *Late Insertion* approach (Section 3.1.8).

[1]The syntax-semantics interface is discussed in Chapter 4.

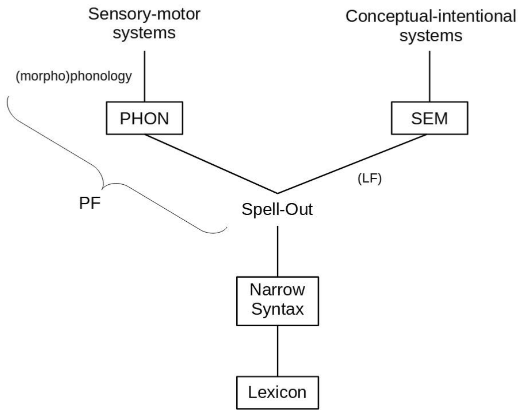


Figure 3.1: The Y-model architecture.

3.1.1 Y-model

Figure 3.1 shows the basic "Y-model" architecture of I-language. The *syntactic derivation* creates mappings between semantic and articulatory interpretations, allocated to the *conceptual-intentional (C-I)* and *sensory-motor (S-M)* systems, respectively. The component responsible for the syntactic derivation is called *Narrow Syntax (NS)*.[2] It takes *syntactic heads* from the *Lexicon* and combines them to yield complex *phrases*. Heads and phrases are both *syntactic objects (SOs)*. The SO derived at NS is linked to C-I and S-M at a stage called *Spell-Out*. This can be interpreted as Spell-Out triggering *instructions* to S-M and C-I, denoted here as *PHON* and *SEM* (Chomsky 2001b, Pietroski 2011).[3]

The pre-Minimalist G&B-theory (Chomsky 1981, 1982, 1986a, Haegemann 1994) further separated the SO to two branches after Spell-Out, called *PF* (for "Phonological Form") and *LF* (for "Logical Form"). The LF component has no major role in this dissertation. In contrast, PF is highly relevant in accounting for linguistic variation and bilingualism (Sections 3.2–3.3). Broadening the strict G&B reading, I use "PF" as an umbrella term covering everything from Spell-Out to articulation on the left-hand side of Figure 3.1 (see Section 3.1.8).

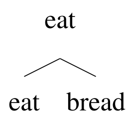
[2]The term "Narrow" is used because other aspects of linguistic processing (such as certain PF-operations: see Section 3.1.8) could also be "syntactic" in a broader sense.

[3]In contemporary Minimalism, Spell-Out is often treated as *cyclic*, taking place in multiple steps called *phases* (Chomsky 2001a, Gallego 2010). I abstract away from this here.

3.1.2 Merge

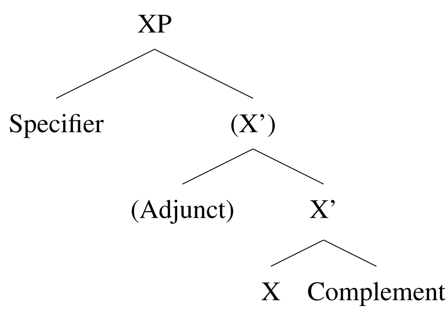
NS can put two SOs together via a basic combinatorial operation called *Merge* (Chomsky 1995a), the result of which is recursively available as an input to its further applications. Merge is typically formulated as binary, outputting the set of its two arguments: Merge(A, B) = {A, B}. The output also inherits the syntactic nature of one of its constituents. For instance, the phrase *eat bread* has a similar grammatical status as the verb *eat*, not the noun *bread*. The asymmetricity can be introduced via a *labeling* operation that selects one of the constituents as the label of the phrase.[4] The result of merging two SOs and labeling the result can be denoted with labeled tree-structures such as (4).

(4)



Example (4) follows *Bare Phrase Structure* (Chomsky 1995b), where the label is identified with the labeling constituent. In more traditional terminology, a complex phrase labeled by its constituent of the category X is called *XP* ("P" standing for *phrase*). In this notation, (4) would be a *VP* (verb phrase) since it is labeled by a verb. Prior to Minimalism, G&B-theory further maintained that all phrases are formed according to the uniform *X'-schema* (Chomsky 1970, Jackendoff 1977), as shown in (5):

(5)



A *head* X is a syntactic head taken from the Lexicon. A *complement* is directly combined with the head, which results in an intermediate *X'-phrase*. A *specifier* is combined with X' to form a *maximal phrase* XP. *Adjuncts* are optional elements that are combined with X' and recursively project a novel instance of it. While many aspects of G&B-theory have been

[4]There is much debate on the nature of labeling (e.g. Chomsky 2008, 2013, Hornstein 2009, Hornstein and Pietroski 2009, Stockwell 2016, Takita et al. 2016, Bode 2020), and some researchers have suggested it should be eliminated if the asymmetries can be introduced by other means (Collins 2002, Seely 2006, Narita 2014).

abandoned in Minimalism (for reviews, see Hornstein and Grohmann 2006, Boeckx 2006), X'-theoretic phrase types have still generally been retained in concrete analyses. This is possible by defining them *relationally*. Chomsky (1995b: 61) defines a *maximal projection* as a SO that does not label another phrase, and a *minimal projection* (i.e. head) as a SO that has no syntactic constituents. An X'-phrase is neither maximal nor minimal.[5]

Hence, a complement is a maximal projection merged with a labeling head, and a specifier is a maximal phrase merged with a labeling X'-projection.[6] Adjuncts remain problematic, since they are not distinguished from specifiers by this relational definition. For present purposes, I simply assume that adjuncts are somehow distinguished from specifiers based on Merge, labeling, Spell-Out, and/or interface interpretation (Lebeaux 2000, Chomsky 2001b, Hornstein 2009, Hornstein and Pietroski 2009, Hunter 2011, Bode 2020).[7]

The most central syntactic relations created via Merge are *dominance*, *sisterhood* and *c-command*. If X = Merge(A, B), then (i) A and B are sisters; (ii) X dominates both A and B as well as everything they dominate; (iii) A c-commands B and everything B dominates; and (iv) B c-commands A and everything A dominates.[8]

3.1.3 Movement

NS can also re-introduce a SO to a higher position. Many languages use such *movement* in so-called *wh*-questions, including English. This is shown in (6), where the original position of the *wh*-pronoun is indicated by strikeout:

(6) Who did you see ~~who~~

In both early transformational grammar and G&B-theory, movement was treated as a *sui generis* operation (Chomsky 1965, Haegemann 1994). Later, it was re-formulated within Min-

[5]Unlike classical X'-theory, these definitions also allow projections that are both maximal and minimal (Chomsky 1995a: 249). A relational reconstruction of X'-bar theory was already suggested by Muysken (1982).

[6]Starke (2004) argues that specifiers should be removed from the analysis altogether, resulting in several large-scale changes to the theory. I do not consider this alternative here, but see Lohndal (2014: 85–88) for discussion and critique. Lohndal (2014) also argues that specifiers *qua* specifiers are eliminable from the analysis of syntactic derivation. This can be achieved with an analysis where complex phrases are turned back into atomic heads by removing their sister from the derivation via a cyclic Spell-Out. While retaining this possibility, I continue to use the term "specifier" for non-adjunctive phrasal sisters of X'-projections.

[7]Some "adjuncts" might also be re-analyzable as specifiers of dedicated functional heads (Cinque 1999).

[8]C-command was originally introduced by Reinhart (1976). A notable characteristic of the Minimalist framework is that it arises as an automatic consequence of Merge (Hornstein 2009: 17–52, Preminger 2014: 96).

imalism as a re-application of Merge to an element already present in the SO (Chomsky 1993, Bošković and Nunes 2007). Deleting the lower copy can be allocated to PF rather NS. This *copy-theory of movement* is illustrated in (7), where YP contains XP:

(7) Merge(XP, [$_{YP}$ (...) XP (...)])

Movement can also target *heads*, such as verbs in English *yes/no*-questions like (8):

(8) Have you ~~have~~ been here?

A major debate concerns whether head-movement should be allocated to NS (Baker 1988, Roberts 2010), PF (Chomsky 2001a, Boeckx and Stjepanovic 2001), or some combination thereof (Matushansky 2006, Harizanov and Gribanova 2019). I remain agnostic about this question (but see Section 3.2.2 for further discussion).

3.1.4 Agree

Properties of a SO can depend on their syntactic environment. For example, English manifests a (partial) person- and number agreement on the verb, as in (9):

(9) a. A dog run-s
b. Dogs run-∅

A dominant view is that SOs enter into an *Agree* relation if one has an "uninterpreted" variant of a feature, and the carries other an "interpreted" variant of the same feature (Chomsky 2000a). Various modifications of this basic account have been proposed (e.g. Bošković 2007, Baker 2008, Zeijlstra 2012, Preminger 2014). Other alternatives include treating Agree as a variant of movement (Hornstein 2009) or a PF-operation (Bobaljik 2008). While a PF-analysis would fit well with my overall approach to linguistic variation (Section 3.2), I make no assumptions about locating Agree to either NS or PF. As argued in Section 3.3.3, *both* alternatives allow variation concerning Agree to arise via PF – at least indirectly.

3.1.5 Roots and categorizers

The *Lexicon* is the repository of syntactic heads. Following DM, I distinguish between *roots* and *functional heads*, discussing the former here and the latter in Section 3.1.6. Traditional lexical categories include at least noun (N), verb (V), and adjective/adverb (A). The status of prepositions (P) is more contested (e.g. Jackendoff 1973, Grimshaw 1991, Svenonius 2008), and will be discussed later (Section 3.2.3; Chapter 4, Section 4.3.2). For now, I focus on noun and verb as paradigmatic lexical categories.

G&B-theory and standard Minimalism take lexical heads to contain their categorical identities in the Lexicon (e.g. Baker 2003). In contrast, DM treats *categorizers* as separate syntactic heads (Halle and Marantz 1993, 1994, Marantz 1997, Panagiotidis 2015). At NS, categorizers are merged with category-free elements called *roots*. Example (10) illustrates the difference, with the lexicalist variant on the left and the DM variant on the right:[9]

(10) a. V run — $[_{vP}$ v $\sqrt{run}]$

b. N dog — $[_{nP}$ n $\sqrt{dog}]$

Early DM treated roots as unindividuated in NS (Marantz 1995a,b). Here, NS only contains one generic root $\sqrt{}$, which is mapped to PHON and SEM after Spell-Out. However, this analysis is insufficient within the basic Y-model, as the PHON-SEM link remains undetermined. Additional post-syntactic interaction between the interfaces would be needed; otherwise, there is nothing hindering e.g. the PHON /dog/ being linked to the SEM 'cat' (Harley and Noyer 1999). Subsequent variants of DM have commonly assumed the standard Y-model without such direct interface links.[10] This leaves three main alternatives for root individuation: *semantic*, *phonological*, or *formal*.

Arad (2005) proposes that roots specify a semantic core. However, it is not always possible to find any such core across all words that contain the same root. As an example, the Hebrew root $\sqrt{kb\hat{s}}$ is used in words with meanings ranging across 'pickled fruit', 'compression', and 'conquer', among others (Aronoff 2007: 819, Panagiotidis 2015: 93). Such *root polysemy* motivates root individuation by other means (Borer 2005a,b, Harley 2014).[11]

[9]In line with standard DM notation, roots are marked with the square root symbol and categorizers with lower-case versions of the lexical categories.

[10]In a more recent paper within the *Nanosyntax* framework (Starke 2009, Caha 2009), Vanden Wyngaerd et al. (2021) propose that roots are not differentiated in syntax but root suppletion is possible via a cyclical process of phrasal Spell-Out. I leave further discussion of this analysis for future work.

[11]Polysemy is discussed in more detail in Chapter 4 (Section 4.3.1).

Singular	Plural	Translation
vuite	tenne	'run'
weama	rehte	'wander'
kivake	kiime	'enter'
vo'e	to'e	'lie'
weye	kaate	'walk'
mea	sua	'kill'

Table 3.1: Verbs with suppletive plural agreement in Hiaki (Harley 2014: 234).

Another possibility is to identify roots phonologically. In one prominent version of DM, roots have PHONs already in the Lexicon, while functional heads receive PHONs after Spell-Out (Embick and Noyer 2007, Embick 2015). Borer (2005a,b, 2013) also adopts a similar view outside of DM. The main challenge for this alternative stems from *root suppletion*, where a single root can have multiple unrelated phonological realizations. Examples from the Hiaki language are provided by Harley (2014), reproduced in Table 3.1.[12]

A further problem with phonological root individuation is *homonymy*. Non-phonological means are needed for differentiating between "accidental" homonyms which have no plausible common root, such as the English *bank* (river slope vs. financial institution), *bat* (flying animal vs. sport equipment), or *pen* (writing instrument vs. area for animals). Embick (2015: 8) suggests adding *indices* to homonymous roots, as in $\sqrt{bank_1}$ and $\sqrt{bank_2}$. The index is an additional non-phonological marker of root identity.

Formal individuation of roots removes both PHONs and SEMs from their lexical features altogether. Pfau (2009) argues for a generic index notation where roots only have formal identity markers: $\sqrt{1}$, $\sqrt{2}$, etc. This view has since been commonly adopted in DM (Siddiqi 2009, Harley 2014, Aquaviva and Panagiotidis 2012, Aquaviva 2014a,b, Panagiotidis 2015).

In this dissertation, the main questions concerning roots are related to their SEMs, which I argue to be inserted post-syntactically (Chapter 4, Section 4.3.2). My PF-based analysis of

[12]To allow seeming root suppletion within the phonological analysis of roots, Borer (2013) argues that certain roots have *gaps* in where they can occur. When syntactic positions are complementary for two roots that also have the same SEM, this results in "suppletion". For example, the Hiaki $\sqrt{vuite}$ and $\sqrt{tenne}$ (see Table 3.1) would be distinct roots that share the same SEM, such that $\sqrt{vuite}$ could occur only with a singular subject and $\sqrt{tenne}$ only with a plural subject. Harley (2014: 237–238) objects to this on the grounds that it relies on coincidental co-occurrences in phonological gaps and semantic interpretation.

language differentiation (Section 3.3.3) fits especially well with formal root individuation and the post-syntactic insertion of PHONs. That being said, the main contents of this dissertation are not affected by whether PHONs are pre-syntactically present in roots or not. In practice, I will simply denote roots via the ortographic forms of the related words (e.g. $\sqrt{dog}$, $\sqrt{cat}$), and assume that roots are individuated at NS in some way that allows maintaining distinct roots even for homonyms. This view takes roots to be *at least* formally identitied; leaving further discussion of root-PHONs for future work.

3.1.6 Functional heads

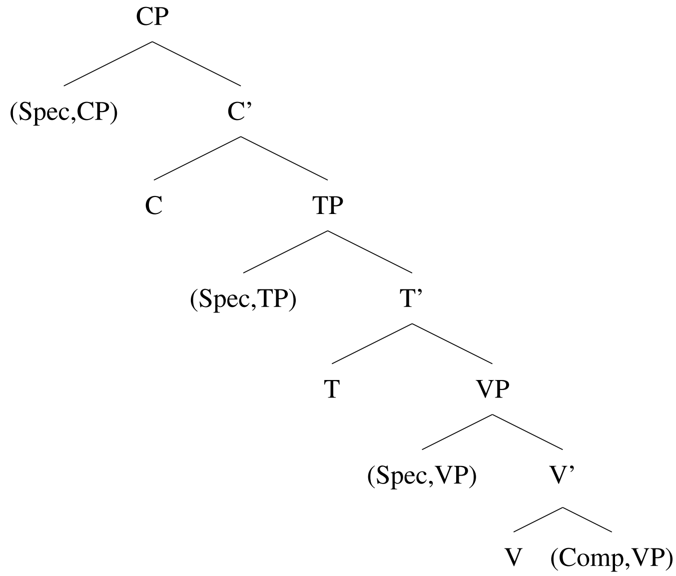
Functional heads were first introduced by Chomsky (1986a), and the theoretical distinction between lexical and functional projections was given by Abney (1987). Alexiadou et al. (2007: 15) review five properties that prototypically characterize functional heads: they (i) form closed classes, (ii) are often phonologically stressless and dependent (e.g. affixes or clitics), (iii) cannot be separated from their complement, (iv) lack descriptive content, and (v) lack thematic arguments.[13]

A universal basic clause structure is ubiquituously assumed in contemporary generative research, with two functional projections in a fixed order. A verb phrase (VP) is merged to a *T*-head specifying tense and related inflectional information. The resulting phrase (TP) is then merged to a *C*-head, adding information about the clause type (such as *Force*: declarative/interrogative/imperative). This CP-TP-VP structure is shown in (11).[14]

[13]The last of these conditions is revised within an *exoskeletal* approach to argument structure (Hale and Keyser 2002, Borer 2003, 2005a,b, Lohndal 2014), as reviewed (and endorsed) in Chapter 4 (Section 4.3.2).

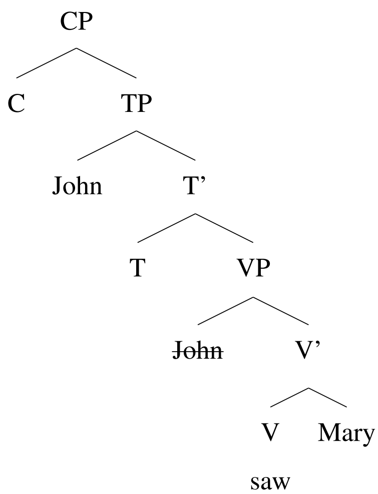
[14]In DM, "VP/NP" corresponeds to a root-categorizer complex (Section 3.1.5). TP was originally called "IP" for Inflection Phrase (Chomsky 1986a). Splitting IP into TP and an agreement-marking *AgrP* was suggested by Pollock (1989), but a separate AgrP has generally been shunned in Minimalism (Chomsky 1995a). Wiltschko (2014) argues for restoring the prior term "I" due to the projection's non-universal connection to tense (see Section 3.1.7). Here, I use the current standard terminology ("T") for convenience. The term "C" is due to complementizers (such as *that*) being located to the C-head (Chomsky 1986a). Nothing hinges on the specific notation adopted.

(11)

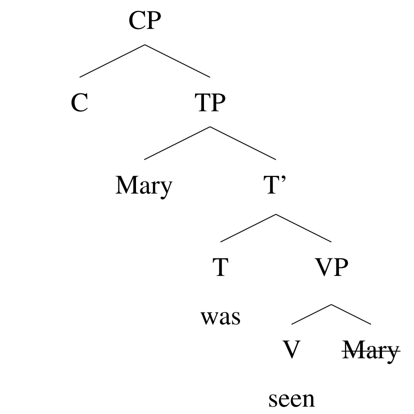


In English, Spec,TP hosts the grammatical subject, and Spec,CP hosts elements moved to the left periphery, such as *wh*-pronouns or focused phrases. Chomsky (1986a) originally assumed that subjects originate in Spec,TP, but later the *VP-internal subject hypothesis* has been commonly accepted (e.g. Speas 1986, Koopman and Sportiche 1991). Here, the subject originates in Spec,VP and subsequently moves to Spec,TP. In passive clauses that lack the lower subject position, the object moves to Spec,TP instead. These cases are shown in (12a–b), respectively. (The analysis of argument structure will be revisited in Chapter 4.)

(12) a.

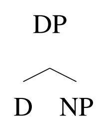


b.



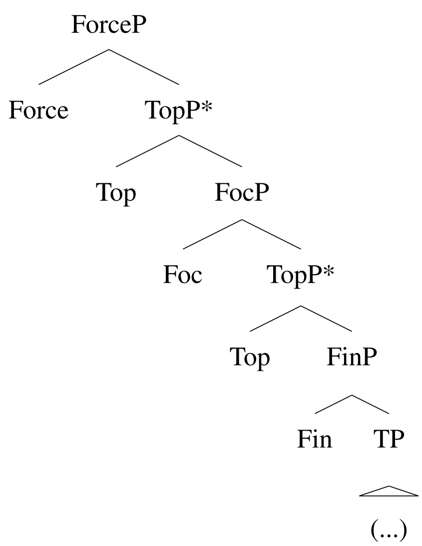
Abney (1987) further argued that a lexical-functional distinction exists within the noun phrase as well, separating the lexical NP from the functional *DP*, as shown in (13).[15]

(13)



Rizzi (1997) proposed splitting CP into ForceP (clause type), FocP (focused elements and wh-pronouns) and FinP (finiteness), with potentially iterable TopPs (topicalized elements) both above and below FocP. This "split CP" is shown in (14).

(14)



[15]The term "DP" is due to *determiners* (articles, demonstratives) occupying the D-head in Abney's (1987) oringinal analysis. In later work, demonstratives have been often been located to Spec,DP instead (Giusti 1997, Lyons 1999, Brugè 2002, Alexiadou et al. 2007), and sometimes even articles have been treated as specifiers (Lyons 1999, Ferrazzano 2013).

Similar expansions have subsequently been done for noun phrases (Giusti 2002, Alexiadou et al. 2007) and adjective phrases (Corver 1997, Bobaljik 2012). This has greatly extended the functional Lexicon, culminating in the *cartographic* framework (Cinque 1999, Kayne 2005, Schlonsky 2010, Cinque and Rizzi 2010, 2016). The increased centrality of functional heads raises further questions regarding categorization and selectional restrictions.

3.1.7 Extended projections and syntactic domains

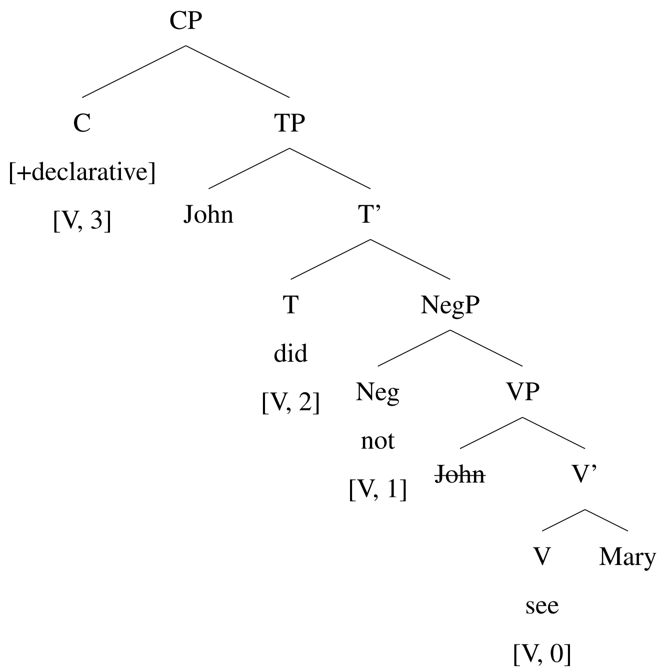
Functional heads are typically category-specific: some modify verb phrases (e.g. T, C) and others noun phrases (e.g. Num, D). Panagiotidis (2015) analyzes this via the Agree relation: categorizers contain lexical features, and functional heads contain their uninterpretable counterparts. Without committing to any specific account of Agree (see Section 3.1.4), the basic idea can be formulated more generally: functional heads contain a categorical feature that needs to match the category of the lexical head (or categorizer) they dominate.

However, category-specificity alone does not account for the *order* between functional heads: why is e.g. C higher than T? One option would be to use *selectional features* that determine which SOs the functional head can be merged with. For example, Collins and Stabler (2016: 63) propose that C has a feature "[__, TP]" for requiring a TP complement. However, complement selection is problematic with *optional* functional heads, such as the negation (Neg). T can be merged with either VP or NegP, but dividing it to two variants with different selectional features would miss an evident generalization.

Grimshaw (1991) coined the term *extended projection* to describe the relation between functional phrases and the lexical phrases they modify. TP and CP are verbal extended projections, and DP is a nominal extended projection. She further describes the selectional constraints of functional heads by two means: (i) the lexical category they extend, and (ii) a *number* that needs to be higher than the complement's number. Lexical heads have a special number [0], which allows beginning an extended projection.

Consider the example sentence *John did not see Mary*. The verb *see* begins the derivation by taking thematic arguments. Then a negation (Neg) is added, followed by a tense-marking auxiliary (T) and a declarative marker for the clause type (C). Abstracting away from other functional heads, the verb can be analyzed as [V, 0], Neg as [V, 1], T as [V, 2], and C as [V, 3]. The resulting CP is shown in (15):

(15)



Selectional constraints are based on the *successor* relation instead of direct complement selection. If Tense directly selected its complement, it would have to select V in affirmed clauses and Neg in negated clauses. In contrast, here T can merge with either V or Neg because both satisfy the relevant conditions (for a similar account, see Adger 2010).

However, there is yet another contrast between functional heads, not captured by Grimshaw's account alone. Since the expansion of T and C into multiple functional heads, they have often been reformulated as *domains* (Grohmann 2003, van Gelderen 2013, Wiltschko 2014). Neg and T both belong to the same domain – the "split TP" – while C does not.

Support for domains comes from three main sources: *word-order*, *movement*, and *semantics*. Variants of the C-T-V order have been succesfully applied to a large and diverse set of languages (e.g. Baker 2001, Julien 2002, Grohmann 2003, Rizzi 1997, Roberts 2007, 2019, Adger et al. 2009, Cinque and Rizzi 2010, 2016, Wiltschko 2014).[16] This order is thus a viable candidate for a universal syntactic generalization manifested in all I-languages.

[16] The most typologically extensive of such studies is Julien (2002), which compares verb morphology and clausal word-order across 530 languages. Julien argues for a strictly syntactic approach, where word-order is determined based on Kayne's (1994) *Linear Correspondence Axiom*, and morpheme-order within complex heads (derived via head-movement) is determined based on Baker's (1985) *Mirror Principle*. While less restrictive approaches to linearization also exist (see Section 3.1.8), Julien's study corroborates the underlying syntactic hypothesis of the C-T-V order being reliably reproduced across many typologically diverse languages.

Nevertheless, word/morpheme order is not always fixed between corresponding functional heads across languages. For example, Finnish and English exhibit different orders between the negation and modal auxiliaries, as shown in (16)–(17):

(16) a. Pekka ei voi voittaa kilpailua
Pekka.NOM not can.3SG.PRES win.INF contest.SG.PART
'Pekka cannot win the contest'

b. *Pekka voi ei voittaa kilpailua

(17) a. John might not win the contest

b. *John not might win the contest

The variation also impacts semantic interpretation: in (16a) the modal is in the scope of the negation, whereas in (17a) the negation is in the scope of the modal. Thus, Finnish and English genuinely differ in the order of these functional heads in the T-domain. The C-domain also exhibits similar variation. For example, languages differ in whether Topic positions appear above or below the Focus head (Cinque and Rizzi 2016: 147). Overall, the order of equivalent functional heads can vary between languages, but only *within a domain*.

Additional syntactic evidence for domains arises from *movement dependencies*. A central notion in Minimalism has been that syntactic operations are *local*: they apply between the structurally closest elements of the relevant kind (Collins 1997, Stroik 2009). However, certain phenomena exhibit *anti-locality*, where operations cannot be too local (Grohmann 2003, 2011). Such effects are commonly domain-bound.

Akin to earlier work by Plazack (2000), Grohmann (2003) divides the clause into three domains that correspond to the split VP, TP, and CP with dedicated grammatical functions: the *Θ-domain* for thematic relations (VP), the *Φ-domain* for agreement (TP), and the *Ω-domain* for discourse information (CP). Anti-locality manifests as the impossibility of intra-domain movement. A simple example concerns the ban against object-subject movement in English. Thematic objects can move to the grammatical subject position in passive clauses like (18a), but they cannot appear as the thematic subject of a transitive verb, as in (18b). The corresponding interpretation can only be achieved by using a reflexive pronoun, shown in (18c).

(18) a. [$_{TP}$ Mary was [$_{VP}$ seen ~~Mary~~]]

b. [$_{TP}$ *Mary [$_{VP}$ ~~Mary~~ saw ~~Mary~~]]

c. [$_{TP}$ Mary [$_{VP}$ ~~Mary~~ saw herself]]

Movement from Comp,VP to Spec,VP in (18b) would stay within a domain, while movement in (18a) and (18c) takes place across domains. Grohmann (2003) uses the restriction against intra-domain movement to unify a range of previously observed anti-locality effects (Bošković 1997, Saito and Murasugi 1999, Pesetsky and Torrego 2001, Abels 2003).[17] This line of research has been extended to cover multiple languages (Ticio 2005, Cheng 2006, Schneider-Zioga 2007) as well as other phenomena, including demonstrative doubling (Grohmann and Panagiotidis 2005), prosodic stress assignment (Grohmann and Putnam 2007), scrambling (Putnam 2007), and lexical category switching (Panagiotidis and Grohmann 2009).

With respect to semantics, Ramchand and Svenonius (2014) attach domains to dedicated interpretations, where the V-domain specifies an *event* (Davidson 1967a, Higginbotham 1985, Bach 1986, Parsons 1990) and the T-domain specifies a *situation* (Barwise and Perry 1983, Kratzer 1989, Devlin 2006). The C-domain then existentially closes the situation and links it to a *proposition* anchored to the discourse (Giorgi 2010).

Wiltschko (2014) proposes four semantically grounded domains with language-specific manifestations. *Classification* corresponds to the V-domain and *linking* to the C-domain. *Point-of-view* and *anchoring* represent lower and higher layers of the TP. A significant contribution here and in related work (Wiltschko 2013, Ritter and Wiltschko 2014) is the detailed examination of domains in non-Indo-European languages (such as Halkomelem and Blackfoot). This work illustrates that – while languages differ in specific functional heads – a higher level of universal semantic analysis can effectively capture domains.

In sum, the division of extended projections into domains receives support from word-order, movement dependencies, and the domain-specificity of SEMs. Theoretically, an attractive prospect would be to explain domains as a syntax-semantics interface phenomenon. However, they can also manifest in NS (as in constraints on movement) and even phonology (Grohmann and Putnam 2007), which indicates that they are already available at NS.[18] Here, I simply adopt the view that functional heads in an extended projection are divisible into three domains that correspond to the split VP, split TP, and split CP in the clause.[19]

[17]Grohmann (2003) also uses domains to distinguish *A-movement* from *A'-movement* (e.g. Baltin 2001).

[18]Another possibility could be that domains are created via cyclic Spell-Out, akin to *phases* (Chomsky 2001a). Grohmann (2003) advocates this, but distinguishes domains from phases despite their surface similarities: in particular, TP is a domain but not a phase for Chomsky (2001a).

[19]I discuss Wiltschko's (2014) four-domain analysis further in Chapter 4 (Section 4.3.3), maintaining that her insights can be incorporated into the three-domain analysis.

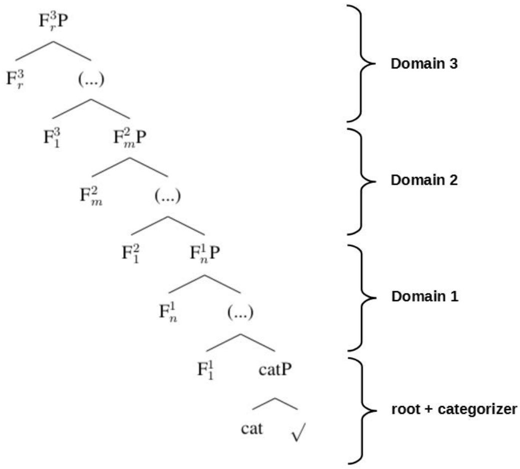


Figure 3.2: Generic structure of an extended projection with syntactic domains.

The generic structure of an extended projection is shown in Figure 3.2, adopting the number notation of Grimshaw (1991) (and Adger 2010) in a domain-bound manner. Here, $\surd$ is a root, cat is categorizer, $\{n, m, r\}$ are the highest numbers for functional heads in each respective domain, and F^i_j is a functional head in Domain i with the number j. The structure begins with merging a root with a categorizer. Functional heads are then added in a manner that respects two restrictions. First, domains appear in the order 1–3. Second, functional heads must have a higher number than prior functional heads in the same domain. Consequently, a functional head with a number lower than that of its complement can only be merged if it begins a new domain. Functional heads are also category-specific, where the category is typically retained throughout the extended projection.[20] A simple taxonomy of syntactic heads thus emerges: each head is a root, a categorizer, or a functional head in one of the three domains.

3.1.8 The PF interface

NS affects both SEM and PHON via Spell-Out. *LF-operations* would only affect SEM and result in "covert syntax" invisible to S-M (see Section 3.1.1). Similarly, *PF-operations* would only affect PHON and result in semantically uninterpreted syntax invisible to C-I. Since I do not rely on LF-operations in this dissertation, I limit the discussion to PF.

[20]This generalization would need modification to accommodate *recategorization*, such as the nominalization of verbs (Moulton 2004, Pires 2006, Panagiotidis and Grohmann 2009, Panagiotidis 2015). I leave its incorporation for future work (although participial clauses are briefly discussed in Chapter 6, Section 6.5.18).

DM locates various operations to a pre-phonological PF-component that manipulates SOs prior to assigning PHONs, called *Morphology*. Common Morphology operations are listed in Table 3.2 (see e.g. Marantz 1988, Bonet 1991, Halle and Marantz 1993, 1994, Halle 1997, Noyer 1998, Harley and Noyer 1999, Embick and Noyer 2007, Bobaljik 2015).

Operation	**Description**
Impoverishment	deleting or changing features
Fusion	collapsing sister heads into one Vocabulary Item
Fission	expressing features of a head with more than one Vocabulary Item
Feature copying	copying a feature from one head to another
Feature insertion	adding a feature that is not present in NS
Node insertion	adding a syntactic node that is not present in NS
Morphological Merger	replacing a syntactic relation between X and Y by affixing X to Y

Table 3.2: Morphology operations in DM.

Head-movement has also often been allocated to PF for alleviating its problems with the copy-theory of movement (Chomsky 2001a, Boeckx and Stjepanovic 2001, Adger 2013a, Platzack 2013), and PF-movement has even been proposed for phrases (Embick and Noyer 2001). However, Morphology could be criticized of overcomplicating PF by essentially making it syntactic (e.g. Scheer 2011: 613–634). Furthermore, the operations heavily overgenerate possible structures, most of which are not empirically attested. Going forward, I remain agnostic about Morphology and focus instead on *Vocabulary Insertion* and *Linearization*.

The standard generative view takes the Lexicon to *contain* SEMs and PHONs, which Spell-Out merely *separates* and hands out to the C-I and S-M interfaces. The alternative view adopted in DM – *Late Insertion* – asserts that PHONs are not present at NS. Instead, PHONs are inserted at PF by the Vocabulary Insertion operation. This can be based on both their intrinsic features (*primary exponence*) and their syntactic context (*secondary exponence*). The link between these (morpho)syntactic insertion conditions and the PHON is called a *Vocabulary Item (VI)*.[21] For example, the English past tense suffix is typically *-ed*, but has other variants with certain words: *-t* (e.g. *left*, *caught*, *bent*) or the null morpheme -∅ (e.g. *hit*, *quit*, *run*). Embick (2015: 93) expresses its VIs as in (19):

[21] Vocabulary Insertion applies to heads in standard DM. Alternatives to this assumption include the use of phrasal Spell-Out in *Nanosyntax* (Starke 2009, 2014), and Svenonius' (2016) proposal for insertion based on *spans* (head-complement sequences). I adopt the standard DM variant for concreteness.

(19) a. T[+past] $\leftrightarrow$ -t / $\{\sqrt{bend}, \sqrt{leave}, ...\}$ _

b. T[+past] $\leftrightarrow$ -∅ / $\{\sqrt{hit}, \sqrt{quit}, ...\}$ _

c. T[+past] $\leftrightarrow$ -ed

In (19a–b), the left-hand side of the arrow ($\leftrightarrow$) contains the primary exponence conditions, and the right-hand side of the slash (/) contains the secondary exponence conditions with the underscore (_) denoting (morpho)syntactic position. The last VI (19c) only has primary exponence conditions, and is called an *elsewhere* rule: it applies when more specific conditions for the same item are not met. According to the *Subset Principle* (Halle 1997), a VI is chosen for a SO if (i) all of its conditions are met by the SO, and (ii) it has more specific conditions than any other VI applicable for the same SO. VIs *compete* at Vocabulary Insertion, and the winner is selected based on the Subset Principle.

Complex phrases receive their phonological form via *linearization*. Since Kayne (1994), this has been customarily allocated to PF. Kayne's *Linear Correspondence Axiom (LCA)* maintains that the linear order of X'-structures is universally Specifier-Head-Complement, as more precisely defined in (20) via *asymmetric c-command*:

(20) **Linear Correspondence Axiom (LCA)**:
A precedes B if and only if A c-commands B and B does not c-command A.

The LCA has been influential especially in the cartographic framework (Kayne 2005, Cinque and Rizzi 2010). In complex heads formed via head-movement, its correlate is Baker's (1985) *Mirror Principle*, which reverts the order: if A asymmetrically c-commands B, then B precedes A in the complex head A+B. The LCA and the Mirror Principle are the most influential proposals for universal linearization algorithms in generative linguistics, but both have also been challenged.[22] The DM literature typically maintains a less restrictive analysis of linearization than the LCA, but also locates it to PF (Embick 2007, 2015, Arregi and Nevins 2012, Lohndal and Samuels 2013). In line with this, I assume that PF contains a Linearization operation, which – together with Vocabulary Insertion – yields a concatenation of PHONs as input for further stages of (morpho)phonology and articulation.[23]

[22]Julien (2002) presents evidence across 530 languages in support of the LCA and Mirror Principle. In contrast, Takita (2009) argues that Japanese is genuinely head-final, violating the LCA. Harley (2011) discusses challenges to the Mirror Principle in the Cupeño and Navajo languages.

[23]I denote the PF-component responsible for linearization with the capital initial letter: "Linearization". On its ordering with respect to other PF-operations, see e.g. Myler (2009) and Arregi and Nevins (2012).

3.2 Linguistic variation

Early generative research covered rules for particular languages, but lacked a general account of possible rules (Newmeyer 1996, Lasnik and Lohndal 2013). Focus shifted in G&B-theory, where variation between languages was reformulated via *parameters* selected on top of universal *principles*. The most prominent principle was the X'-theory (see Section 3.1.2), and others concerned e.g. co-referring elements, empty categories, and movement (Chomsky 1981, 1982, 1986a,b, Haegemann 1994). The range of parametric choices was also considered universal, only their selection being language-specific.[24]

Subsequently, a dominant aim has been to locate parameters to functional heads in the Lexicon, known as the *Borer-Chomsky conjecture* after Borer (1984) and Chomsky (1995a). An even more restricted approach to variation would be locating them to PF, which has been proposed as a theoretical goal (Boeckx 2011, 2014a,b, Berwick and Chomsky 2016) but has so far remained less widely applied in concrete analyses.

This section reviews loci of grammatical variation within the linguistic framework specified in Section 3.1. I argue that each can be allocated to either the Lexicon or PF. That is, NS, SEM, or their interface (see Chapter 4) need not be differentiated between languages. Initially, the present approach thus seems to favor the Borer-Chomsky conjecture. However, its lexicalist foundation will later be revised in Section 3.3.

3.2.1 Presence of syntactic heads/features

Some languages grammatically mark information that others leave undetermined. For instance, Chinese lacks tense, Finnish lacks gender (except in pronouns), and Pirahã has been suggested to lack number (Everett 2005). Additionally, languages that mark the same grammatical category can differ in its *values*. For example, gender is highly variable across languages that mark it: some languages base it around the masculine-feminine distinction, others on the human-nonhuman distinction, and many on neither (Corbett 1991). Finally, languages can vary in the *order* of functional heads, as discussed in Section 3.1.7.

[24] This view is known as the "switchboard" metaphor of parameters, originally attributed to James Higginbotham (Rizzi 2014: 18). In contemporary research, it has been prominently maintained by Mark Baker (1996, 2001, 2003, 2008, 2015). However, the notion of parameter has also received criticism, including within generativism (Newmeyer 2005, Lohndal and Uriagereka 2010, Boeckx 2011, 2014a,b).

Hence, a central point of variation is which functional heads are *active* in the language. Assuming the universality of lexical categories and syntactic domains (see Section 3.1.7), all other aspects of functional heads are open to variation: their presence or absence in the language, their range of possible values, and their position within the relevant domain. The language-specificity of roots is a debated topic (see e.g. Alexiadou and Lohndal 2017a), but the present framework also allows it by default. Chapter 4 (Section 4.3.1) discusses the SEMs of roots in more detail, and further advocates their ability to vary between languages.

The standard analysis of the activity of a syntactic head H in language L is that L has a dedicated Lexicon that contains H. For example, a Tense-marking T-head is present in the English-Lexicon but absent from the Chinese-Lexicon. For now, this analysis can be maintained.[25] In Section 3.3.3 it will be revised in favor of the view that the activity of syntactic heads arises from their *pronounceability* via language-specific PF-rules.

I follow standard DM (and Minimalism in general) in assuming that multiple features can be bundled together into the same head (e.g. Bobaljik 2015, Embick 2015), although this is not central for my overall purposes.[26] Consequently, languages can vary not only in which features are present but how they are bundled across heads.

3.2.2 Movement

Some languages move certain elements to certain positions, whereas others do not (at least overtly). For instance, Chinese and Japanese lack (at least overt) *wh*-movement of a question phrase (*what*, *who*, *where*, etc.) that targets Spec,CP in English. Huang (1982) argued that even such *wh-in-situ* languages contain the same movement of the *wh*-element to Spec,CP, but only covertly in the LF-component. As an alternative, Bobaljik (2002) proposes that the movement takes place prior to Spell-Out in all languages, but *wh*-in-situ languages pronounce the lower rather than the higher copy at PF. Both of these analyses make *wh*-movement invariable across languages from the perspective of SEM.

[25]Functional heads can also vary in their *mandatory* or *optional* status. For instance, a T-head is mandatory in the English clause (hosting *to* in infinitives), while the Focus head is not (since no element needs to be focused). The explanation of this distinction is not straight-forward, and needs to be allocated to future work.

[26]The cartographic framework (Kayne 2005, Cinque and Rizzi 2010, 2016) and Nanosyntax (Starke 2009, 2014, Caha 2009), allocate each feature to its own head, which would also be compatible with my general approach. Sigurdsson (2004) and Boeckx (2014a) suggest even more drastic reductions of lexical features. For general discussion of features in Minimalism, see Adger (2010) and Adger and Svenonius (2011).

However, some variation in movement influences SEM. For example, possessor arguments in appear high in English DPs such as (21a), occurring before numerals. The numeral-possessor order (21b) is ungrammatical in English. In contrast, Finnish allows the possessor to either precede or succeed the numeral, as in (22a–b):

(21) a. Mary's three books

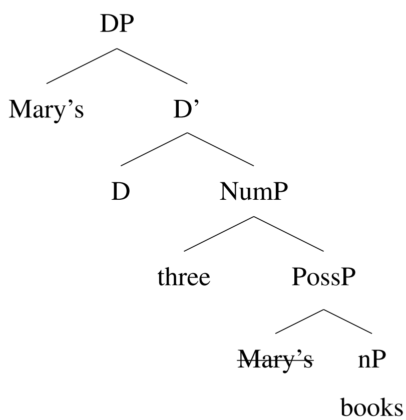
b. *three Mary's books

(22) a. Merjan kolme kirjaa
Merja.GEN three book.PART
Merja's three books

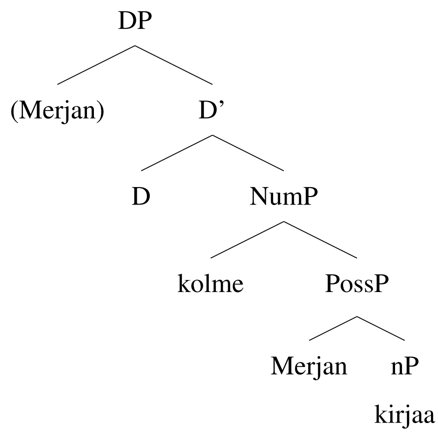
b. kolme Merjan kirjaa
three Merja.GEN book.PART
three books of Merja

The interpretation also has an impact on the scope of the numeral and possessor, where the prior element in linear order is interpreted as taking scope over the lower one. In Gröndahl (2014: 54) I argued that this is due to possessor being base-generated to the lower position under the numeral, and obligatorily raising to Spec,DP in English but only optionally in Finnish. This is shown in (23), where the numeral projection is called NumP and the original possessor-introducing position PossP (remaining agnostic about its specific status), and the parentheses in (23b) denote the optionality of movement. (X'-positions are omitted for simplicity.)

(23) a. English:



b. Finnish:



Hence, even if the distinction between *wh*-movement and *wh*-in-situ languages was a surface-level phenomenon, the English-Finnish difference with respect to the possessor-numeral scope demonstrates that at least some variation in movement affects NS and SEM.

Since G&B-theory introduced movement as an unrestricted operation (called Move-α), its variation has generally been motivated by independent factors (Lasnik and Saito 1992). In early Minimalism, some functional features were considered "weak" and others "strong", where a functional head with a weak feature requires a SO with the strong variant to move to its specifier (Chomsky 1995a). For example, languages like English have a weak [WH] feature on C, which induces *wh*-movement to Spec,CP. More recent Minimalist analyses have often shifted to motivating movement by feature checking via *Agree* (Chomsky 2000a, 2001a), together with a movement-inducing feature called the *EPP*.[27]

The initial formulation of the EPP was that *a clause requires a subject*, where the subject position is Spec,TP (Chomsky 1982).[28] In English active sentences, the Agent argument raises to the subject position. In passives, the thematic object raises to the subject position instead, as no subject is available. In clauses that lack both a subject and an object, an *expletive subject* is inserted to Spec,TP. An example of each case is shown in (24a–c):

(24) a. John [$_{VP}$ ~~John~~ saw Mary]

b. Mary was [$_{VP}$ seen ~~Mary~~]

c. It [$_{VP}$ rains]

[27]Hornstein (2009: 152) questions whether this analysis actually explains movement via Agree, since it relies on the additional EPP assumption.

[28]The term "EPP" originally comes from "Extended Projection Principle", where the *Projection Principle* was the requirement that verbs project a X'-structure with determinate thematic argument positions (Baker 1988).

Explaining movement via either feature strength or Agree(+EPP) locates its variation to the Lexicon. Multiple researchers have also suggested that the EPP should be treated as a PF-condition, effectively stating 'my specifier needs to be articulated' (Holmberg 2000, Bobaljik 2002, van Craenenbroeck and den Dikken 2006, Landau 2007). Fulfilling this condition requires the specifier to be present, and hence to be filled via movement or expletive insertion (either at NS or at the latest via PF-syntax, if such exists). It would thus be an example of a *well-formedness condition* that the SO needs to fulfil for the derivation to converge at PF.

Head-movement can also vary between languages, as covered in Chapter 6 (Section 6.5.2) for verb-movement in Finnish and English. The syntactic status of head-movement is unclear (see Section 3.1.3), but many prominent analyses make its variation straight-forward to motivate by the Lexicon and/or PF. This trivially applies to the large number of proposals that allocate head-movement entirely to PF (e.g. Chomsky 2001a, Boeckx and Stjepanovic 2001, Adger 2013a, Platzack 2013, Berwick and Chomsky 2016). On the other hand, even if head-movement existed in syntax, it could either be analyzed as similar to phrasal movement (Harizanov and Gribanova 2019) or via Agree (Roberts 2010).

3.2.3 Agreement and case

Agreement results in a syntactic head's PHON varying based on its context, such as which other features it stands in a c-command relation to. In (25) from Finnish, verbs agree with the subject in person and number.

(25) a. minä juokse-n
1SG run-1SG

b. sinä juokse-t
2SG run-2SG

c. hän juokse-e
3SG run-3SG

d. me juokse-mme
1PL run-1PL

e. te juokse-tte
2PL run-2PL

f. he juokse-vat
3PL run-3PL

The Lexicalist *feature checking* approach to agreement takes SOs to come pre-equipped with agreement morphemes, which are then checked via the Agree relation. Another similar view treats agreement as *feature sharing*, where the agreeing element contains an *unvalued* variant of the feature, which then receives a value via Agree (Chomsky 2000a, 2001a). In both, variation in agreement reduces to lexical differences in the distribution of interpretable(/valued) and uninterpretable(/unvalued) features on functional heads. An alternative view treats agreement as a PF-operation (e.g. Bobaljik 2008). This *insertion* approach maintains agreement morphemes are added only after Spell-Out.

Agreement and *case* are often treated as mutually dependent in some way. In standard Minimalism, case is checked by the Agree operation at NS. In contrast, McFadden (2004) argues that case is a post-syntactic property added after Spell-Out. Due to the interaction between morphological case and agreement, lexicalist or PF-based analyses of case often go together with corresponding analyses of agreement: either both are visible already at NS (e.g. Preminger 2014) or both are post-syntactic (e.g. Bobaljik 2008).

Baker (2015) proposes that case can be assigned either in conjunction with agreement or as a *dependent case*. In the latter variant, a noun phrase is assigned a particular case if it stands in a c-command relation to another noun phrase in the same Spell-Out domain. Baker parameterizes the c-command direction, and uses this to account for the distinction between nominative-accusative and absolutive-ergative languages.[29] He further proposes that dependent case assignment takes place at Spell-Out since it is constrained by Spell-Out domains. As such, it does not require introducing language-specific constraints to NS itself.

In addition to the lexical and post-syntactic treatments, both agreement and case features have also been assigned to dedicated functional heads. Pollock (1989) proposed splitting Chomsky's (1986a) original IP to TP and *AgrP*, where the latter specified agreement between the verb and its argument. This can further be divided into two agreement heads for different arguments: *AgrsP* (subject) and *AgroP* (object). Case has also been argued to occupy its own functional head above D, called "K" (for "Kase") and projecting a *KP* (Lamontagne and Travis 1986, 1987, Loebel 1994, Bittner and Hale 1996).

Semantically empty functional heads have generally been shunned in Minimalism, which has advanced the allocation of case/agreement features to interpretable heads such as T or D

[29]On dependent case, see Burzio (1986), Marantz (2000), Preminger (2014), and Alexiadou and Anagnostopoulou (2020). For typological overviews of ergativity, see Dixon (1994) and McGregor (2009).

(Chomsky 1995a, Holmberg and Plazack 1995). However, there is an important difference between AgrP and KP in this respect. In the framework of Section 3.1, AgrP and TP would belong in the same syntactic domain (the "split TP"), whereas K would introduce a *new domain* above DP, correcponsing to CP in the clause. Given the much-documented parallels between clauses and noun phrases (Jackendoff 1977, Fukui 1986, Lamontagne and Travis 1986, Abney 1987, Ogawa 2001, Koopman 2005), the existence of such a "nominal C" would be expected on independent grounds. I return to this matter in Chapter 4 (Section 4.3.3).

In sum, agreement and case have been analyzed in three main ways in contemporary generative research: (i) lexical features checked/valued via Agree, (ii) PF-operations, and (iii) dedicated functional heads. Variation in lexical features or dedicated functional heads is an aspect of the more general variation of syntactic heads/features (Section 3.2.1). Alternatively, if agreement and case are PF-phenomena, their variation is also confined to PF.

3.2.4 Word/morpheme order

In G&B-theory, *linearization parameters* determined the order between heads and their arguments. For instance, in a subject-verb-object (SVO) language the verb precedes its complement, whereas in an SOV language the complement precedes the verb. Since Kayne's (1994) *Linear Correspondence Axiom* (LCA), linearization has typically been allocated to PF instead of NS (see Section 3.1.8). Kayne further maintained that X'-structures are universally linearized in the specifier-head-complement order. Here, seeming complement-head order would only arise via movement of the complement to higher a specifier position. In (26), the YP-X order is generated via YP's movement in this way.

(26)

YP (...)

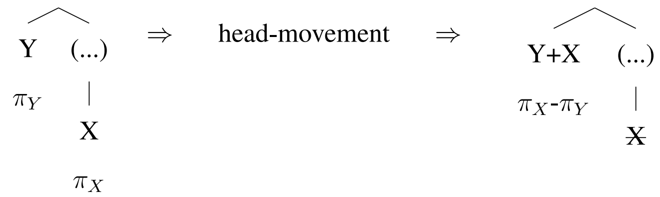
XP

X ~~YP~~

Following both the LCA and standard DM, I assume that linearization takes place at PF (Embick and Noyer 2007, Embick 2007, 2015, Arregi and Nevins 2012, Lohndal and Samuels 2013). If it allows variation, this does not threaten the language-invariance of NS or SEMs. Alternatively, if the LCA holds, variation in linear order follows from movement, as discussed in see Section 3.2.2.

The corollary of the LCA in word-internal morpheme order is the *Mirror Principle* proposed by Baker (1985). Here, if a head X has moved to a higher head Y, the PHON of X precedes the PHON of Y. This is shown in (27), where π_X and π_Y are the PHONs of X and Y.

(27)



Like the LCA, the Mirror Principle has been prominently applied across a wide range of languages, but has also been challenged on empirical grounds (Baker 1985, 1988, Alsina 1999, Brody 2000, Julien 2002, Adger et al. 2009, McPherson and Paster 2009, Harley 2011). I adopt the same approach to it as to the LCA: retaining agnosticism about its universality, and only committing myself to the Linearization algorithm residing at PF.

Finally, as discussed in Section 3.2.1, equivalent functional heads can vary in the order they appear between languages, such as the negation and modal auxiliaries between Finnish and English. This can manifest as word-order variation, if the respective functional structures are linearized correspondingly.

3.2.5 (Morpho)phonology

After Vocabulary Insertion, the PHON can be further modified via *(morpho)phonological* operations that alter phonological features based on morphological or phonological context.[30] Phonological computation also specifies *metrical* structure concerning stress assignment.

Standard generative phonology has assumed that the set of phonological features is universal (Chomsky and Halle 1968). Even if this is true, languages can still vary significantly in which features are used, and how they are grouped into phonemes. First, a feature might be totally absent from a language: for example, Finnish lacks the feature [+uvular]. Second, a feature might be present but not used in all phonological distinctions: for example, Finnish has a [+/-voiced] distinction in plosives but not in sibilants (in contrast to e.g. Russian). Furthermore, the universality of phonological features has been questioned from various theoretical perspectives (e.g. Blaho 2007, Mielke 2008, Boersma 2012, Odden 2013, 2021).[31] For the pur-

[30] The generative tradition in phonology was initiated by Chomsky and Halle (1968). For general introductions to phonological theory, see e.g. Jensen (2004), Odden (2005), and Bale and Reiss (2018).

[31] As Mielke (2008: 16) points out, the existence of *sign languages* already suggests that phonological features

poses of this dissertation, there is no need to go into further detail on phonological features. Uncontroversially, at least their *manifestation* varies.

(Morpho)phonological operations modify the values of phonological features based on contextual specifications. For example, Finnish suffixes use either front- or back vowels depending on the position of the vowels in morphemes adjacent to them, as in *minu-lla* ('1SG-ADE') vs. *häne-llä* ('3SG-ADE'). This *vowel harmony* can be analyzed as a morphophonological fronting operation, where the [+/-front] feature values of the suffix vowels are assimilated to the corresponding values of the vowels in the preceding morpheme.

A prominent phonological framework is *Optimality Theory*, according to which the set of phonological constraints is universal, but their mutual ranking varies between languages (Price and Smolensky 1993, Kager 1999).[32] Constraints higher in the language-specific ranking take precedence over lower ones, and the final phonological representation must satisfy the maximal number of relevant constraints. Other approaches have maintained that (morpho)phonology can emerge via general learning processes without universal rules or constraints (Nesset 2008, Donegan 2015, Archangeli and Pulleyblank 2015).

For present purposes, it suffices that (morpho)phonology modifies the original PHON inserted at VI, changing it into the final PHON in a manner that satisfies language-specific rules and/or constraints. If a serial rule-based approach is adopted, I allow rules to be "active" or "inactive" in a language, in a manner discussed further in Section 3.3.3. If a constraint approach is adopted instead (such as Optimality Theory), I allow either constraints themselves or at least their ranking to be language-specific.

3.2.6 Summary: loci of variation at the Lexicon and PF

Table 3.3 pools together the aspects of linguistic variation covered in Sections 3.2.1–3.2.5, along with their basis in the Lexicon and/or PF. Languages differ in which syntactic features are active and how they are bundled into syntactic heads. If the strong/weak distinction and the EPP are added to the range of possible feature contents, this yields a lexical basis for move-

can be construed from a wider range of material than allowed within standard generative phonology. For reviews of sign language phonology, see Sandler and Lillo-Martin (2006: 111–278) and Sandler (2017).

[32]For critical analyses of parallelist ranked constraint -based approaches and defences of traditional serial processing accounts of morphophonology, see Vaux (2008) and Embick (2010).

Variation	Locus	
	Lexicon	PF
Presence of syntactic heads/features	Activity of syntactic heads Bundling of features to functional heads	
Movement	Feature strength EPP	(Head-movement)
Agreement/case	Feature interpretability/valuation Agr/K-nodes	(Node/feature insertion)
Word/morpheme order	Order of functional heads in a domain Movement	Linearization
(Morpho)phonology		Phoneme inventory (Morpho)phonological rules/constraints

Table 3.3: Linguistic variation as a function of the Lexicon and PF.

ment. Alternatively, movement can be motivated by PF-level well-formedness requirements,[33] and head-movement could also reside at PF. Agreement and case can be given a lexical treatment via feature interpretability/valuation, or allocated to PF. Linearization is determined at PF, either universally (as per the LCA and the Mirror Principle), or in a language-dependent manner. Finally, (morpho)phonological variation *ipso facto* concerns PF.

3.3 Division of languages within bilingual cognition

Understanding translation from an I-language perspective requires clarifying how two languages can co-exist in bilingual cognition. This section argues that prior work has not resolved this matter (Sections 3.3.1–3.3.2), and presents a novel proposal that bases language differentiation on *groups of mutually compatible PF-rules* (Section 3.3.3).

3.3.1 Approaches to bilingualism in cognitive psychology

Weinreich (1953) drew a distinction between three types of bilingual speakers. For *compound bilinguals*, languages L1 and L2 are learned in the same contexts, which results in shared meanings. For *coordinate bilinguals*, L1 and L2 are learned in different contexts, resulting in independent systems of meaning. In *subordinate bilinguals*, L1 dominates and L2-meanings are derived via L1. Word representations are separate in each case; what differs is their relationship to *concepts*, which are shared for compound and subordinate bilinguals but not for coordinate bilinguals. Figure 3.3 summarizes the three types.

[33]For detailed proposals of phonological well-formedness reaquirements driving syntactic operations such as movement, see Richards (2010, 2016).

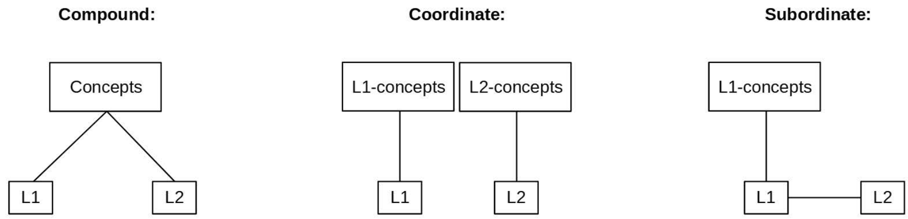


Figure 3.3: Weinreich's (1953) three types of bilingualism.

Psycholinguistic assessments of Weinreich's taxonomy have concerned the dissociability between L1- and L2-concepts, typically measured via memorization speed (e.g. Basi et al. 1997). While it has been widely discussed, there is no general consensus on its validity (Heredia and Cieślicka 2014: 16–17). Still, the distinction between language-specific and language-independent concepts remains crucial. Potter et al. (1984) proposed a distinction between *word-association* and *concept mediation* as alternative ways to account for inter-lingual links within a bilingual speaker. Word association resembles subordinate bilingualism in using non-conceptual surface-level links, while concept mediation resembles compound bilingualism in relying on shared concepts (Potter et al. 1984: 23).

Kroll and Stewart's (1994) *Revised Hierarchical Model (RHM)* aims to unify the word association and concept mediation accounts. As shown in Figure 3.4, RHM separates the lexicons of L1 and L2, but treats the conceptual system as shared. Bilingual lexical access can function in two ways, elaborating Potter et al.'s (1984) distinction. Word association is possible via direct links between the two lexicons,[34] and concept mediation is possible since both languages link to the same conceptual system. RHM predicts that increased bilingual proficiency should make concept mediation more prevalent, whereas word association should be more common among bilinguals with an inferior L2-competence.

A similar idea of a common conceptual store for language-specific lexical items is present in the neurolinguistically motivated *Three-Store Hypothesis* (Paradis 1985, 2004), which maintains that bilingual cognition is neither unified between languages ("one-store") nor completely divided between them ("two-store"). Instead, it contains separate lexical and grammatical systems for each language, as well as a language-independent conceptual system that interacts with these. Meanings are combined in language-specific ways from the shared set of concep-

[34] I use the lowercase notation of "lexicon" here to distinguish the term from the Minimalist concept of the "Lexicon" specifically tied to the Y-model (Section 3.1.1).

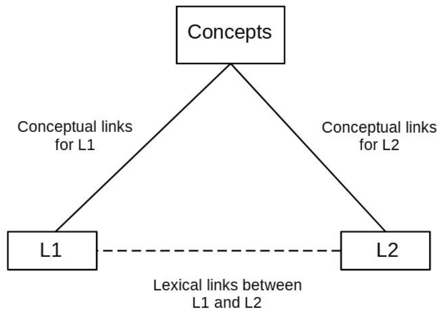


Figure 3.4: Revised Hierarchical Model (Kroll and Stewart 1994).

tual features (Paradis 2004: 198). This language-specific selection of conceptual features is a part of each language system's lexicon.

As Figures 3.3–3.4 illustrate, dominant theories of bilingualism have relied on the assumption that lexicons are language-specific, and hence that linguistic differentiation is somehow maintained in bilingual cognition. Without a further explanation of where this arises, additional "language tags", "language nodes", or "language features" would be needed as markers of linguistic identity (De Bot and Schreuder 1993, Belazi et al. 1994, Green 1998, Dijkstra and Van Heuven 1998, 2002). As MacSwan (2000: 41) shows, this is problematic in multiple ways. First, it extends the range of possible linguistic features indefinitely. Second, delineating the features is highly unclear, since "languages" in common terminology are socio-normative entities not localizable to I-language (Chomsky 2000b, Lightfoot 2011; see Chapter 2, Section 2.2.1). Finally, MacSwan notes that treating "languages" as both manifestations of I-language and features within I-language results in an ordering paradox: if they are generated by I-language, then I-language cannot itself refer to them without vicious circularity. Stipulating "language tags" should thus be eschewed.

3.3.2 Lexicalist Minimalism: two Lexicons and two PFs

Moving on to how bilingualism can be analyzed within Minimalism, a dominant view here is based on the Borer-Chomsky conjencture, which maintains that language variation can be allocated to features in the Lexicon (see Section 3.2). This suggests a differentiation of Lexicons as in the RHM and the Three-Store Hypothesis. PF is also uncontroversially language-specific, at least in part (Chomsky 2001b, 2007, Richards 2008, Berwick and Chomsky 2016). This invites the view that bilinguals have *two Lexicons* and *two PFs*, applied across uniform NS and

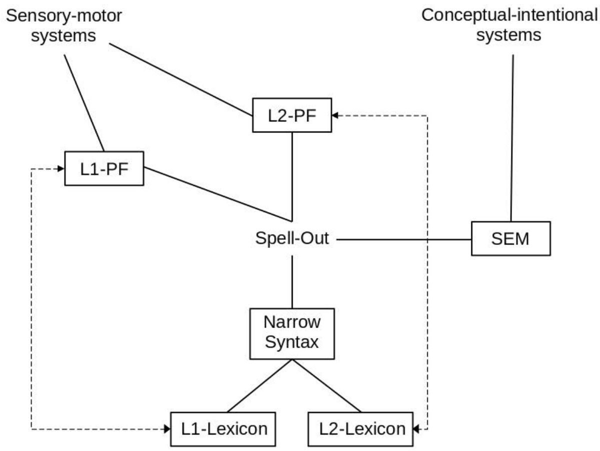


Figure 3.5: Bilingual Y-model with separate Lexicons and separate PFs.

SEM components. Such a lexicalist analysis of bilingualism is shown in Figure 3.5, where the dotted arrows indicate connections between language-specific Lexicons and PFs.

The lexicalist view has been adopted by MacSwan in a monograph (MacSwan 1999) and many subsequent papers (e.g. MacSwan 2000, 2005a, 2016, 2021). His specific purpose is to account for bilingual *code switching* between different languages within the same expression.[35] The theory's premise is that while Lexicons are language-specific, both can feed NS. The syntactic derivation converges if featural requirements are met, irrespective of whether code switching is involved or not. Hence, even though Lexicons are separate, code switching is *possible between syntactic heads*. Examples of English-Finnish code switching are shown in (28), reported by Halmari and Cooper (1998: 87–89):

(28) a. ...he'd won a **palkinto** for being the best **ohjaaja**
'prize' 'director'

b. Mom, there's a vacuum cleaner in the **eteinen**
'hallway'

In contrast to such code-switching between syntactic heads, MacSwan maintains that PF does not allow switching between its language-specific compartments. An central aspect of PF-variation concerns the *ordering* of phonological operations (Bromberger and Halle 1989, Price and Smolensky 1993; see Section 3.2.5). Combining PF-rules between languages could thus result in conflicting orders: if rules R1 and R2 are ordered as R1>R2 in the PF of language

[35] For general linguistic introductions to code switching, see Muysken (2000) and Gardner-Chloros (2009).

L1 and as R2>R1 in the PF of language L2, R1 and R2 would lack an unambiguous order if these PFs were combined (MacSwan 2005b: 72). Assuming that syntactic heads are inputs to PF-rules, the impossibility of PF-level code switching would mean that code switching is *impossible within syntactic heads*. According to MacSwan, this accounts for the ungrammaticality of examples like (29a–b), where a complex word is disallowed when the root morpheme and suffix belong to different languages (MacSwan 2005b: 71):

(29) a. *Juan **eat**-ó
Juan eat(English)-PAST(Spanish)

b. *Juan **com**-ed
Juan eat(Spanish)-PAST(English)

MacSwan's account has the theoretical advantage of exemplifying a *null theory* of code switching (Mahootian 1993): its lacks code switching -specific restrictions such as those proposed in prior generative work (Poplack 1981, Joshi 1985, di Sciullo et al. 1986, Belazi et al. 1994, Halmari 1997). However, it has been criticized especially within alternative DM-based approaches (Lohndal 2013, Grimstad et al. 2014, Alexiadou et al. 2015, Alexiadou and Lohndal 2017a, 2018, Grimstad et al. 2018, López 2020).

In addition to the ban against head-internal code switching, MacSwan is committed to the lexicalist equivocation of syntactic heads with "words", irrespective of their morphological complexity. Together, these assumptions predict that code switching should be *impossible inside a word*. Nevertheless, as reviewed by Alexiadou and Lohndal (2018), word-internal code switching has been documented across many language pairs – including German-Spanish (González-Vilbazo 2005, González-Vilbazo and López 2011), German-Greek (Gardner-Chloros 2009, Alexiadou et al. 2015, Alexiadou 2017a,b), English-Greek (Alexiadou 2011, 2017a,b, Alexiadou et al. 2015), English-Norwegian (Grimstad et al. 2014, Riksem et al. 2019), and English-Telugu (Bandi-Rao and den Dikken 2014). Examples where a root from one language is combined with an affix from another are given in (30) for nouns and in (31) for verbs (all taken from Alexiadou and Lohndal 2018):

(30) a. to regál-i
the.NEUT(Greek) shelf(German)-NEUT(Greek)

b. Segurat-en
security.man(Spanish)-PL(German)

c. road-en
road(English)-DEF.SG.MASC(Norwegian)

(31) a. skan-ar-o
scan(German)-AFF-1SG(Greek)

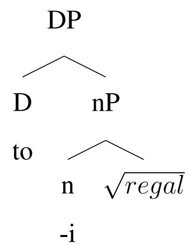
b. utilis-ieren
use(Spanish)-INFL(German)

c. catch-a
catch(English)-PAST(Norwegian)

d. kar(i)g-ify
melt(Telugu)-CAUS(English)

In (30)–(31), one language provides the root and the other determines grammatical properties. DM can account for this via roots lacking grammatical features, which are inserted by functional heads. As Grimstad et al. (2014: 216) argue, this allows combining a null theory of code switching with the notion of a *matrix language*, which provides the "skeletal" structure onto which elements from another language are added. Prior work has typically stipulated the matrix language as a code switching -specific mechanism (Myers-Scotton 1993, 2002, Jake et al. 2002). Here, it can instead emerge from the division of labor between roots and functional heads. For example – assuming that gender is set by the n-categorizer (Kramer 2015) – (30a) can be analyzed as (32), where the German root occurs in Greek functional structure:[36]

(32)



Contrary to the predictions of MacSwan (1999, 2000, 2005a), (32) instantiates word-internal code switching, as syntactic decomposition goes below the level of the word. However, this analysis still remains compatible with the impossibility of code switching within syntactic heads; it only maintains that heads are not assimilable to words. The language-specificity of functional heads is explicitly recapitulated by Grimstad et al.:

> "(...) we assume that the features and feature bundles, known collectively in the DM literature as abstract morphemes, are stored in language-specific lists. (...) Thus, if Norwegian makes use of the feature bundle [+X, +Y, +Z], and a particular

[36]The final morpheme order arises either via head-movement or a lowering operation at PF.

speaker of Norwegian also speaks another language or variety which makes use of the exact same feature bundle, the same bundle will be stored in both lists of abstract morphemes."
(Grimstad et al. 2014: 222)

Hence, even though Grimstad et al.'s DM-approach is non-lexicalist in allowing word-internal code switching, it still retains the basic architecture of bilingual I-language depicted in Figure 3.5. Specifically, Grimstad et al. maintain that functional Lexicons are language-specific while roots are not. This would explain why the same root can appear in syntactic structures of different ("matrix") languages. Despite this caveat, their approach to bilingualism remains committed to separate Lexicons and PFs for each language.

3.3.3 Non-lexicalist alternative: languages as groups of PF-rules

A satisfactory analysis of bilingualism should not rely on "languages" as unanalyzed theoretical primitives. At first, it seems that the Minimalist model with two Lexicons and two PFs could achieve this. However, such a notion recurs when accounting for what *links* the language-specific Lexicon and the language-specific PF. Evidently, maintaining that both "belong to the same language" is not an explanation but only restates the problem.

To avoid stipulating the explicit link between the language-specific Lexicon and PF, at least one of these components should be unified between languages. Given the uncontroversial variability in phonology (Section 3.2.5), the language-specifity of PF seems (at least *prima facie*) difficult to deny. Therefore, I first examine whether dividing the Lexicon is necessary *if* PF is divided. I argue that it is not, since a head's presence in the language-specific Lexicon is always expected to go together with its pronounceability via PF. Subsequently, I look at an even more austere proposal by López (2020), which suggests that both the Lexicon and PF are uniform across languages. Based on these considerations, I propose a novel analysis that grounds language differentiation on PF.

MacSwan makes the following case for separating both Lexicons and PFs:

"Either (a) there is a single lexicon, and each lexical item is marked for a specific set of phonological and morphological rules which yield the appearance of one language or another; or (b) the lexical items in a bilingual's repertoire are mentally compartmentalized in some sense, with a specific set of phonological

> and morphological rules associated with each 'lexical compartment'. The second alternative requires fewer mechanisms, since the morphophonology is associated with sets of elements to which it applies rather than to individual member [sic]. We therefore will assume the latter to be correct."
> (MacSwan 2005a: 6)

This argument is not falsified by word-internal code switching, as it concerns the division of the Lexicon rather than the syntactic status of elements in it (see Section 3.3.2). That being said, I maintain that other considerations favor the PF-account instead.

First, MacSwan assumes that if the Lexicon is unitary, the link between each lexical item and language-specific PF-rules needs to be marked on the *lexical item itself*. Accordingly, if both the Lexicon and PF are divided into "compartments", only the relation between these compartments needs to be maintained, supposedly reducing memory costs. But in *both* cases each lexical item needs to be marked for membership in a language group, as the allocation of a lexical item to a specific Lexicon-compartment needs to be explicitly memorized. It is unclear why this would take less resources than maintaining direct links between lexical items and language-specific PF-compartments.

Second, in Late Insertion approaches, information that a certain lexical item is targeted at PF is not stored on the lexical item but on PF-rules themselves – specifically, *Vocabulary Items* (VIs) (Section 3.1.8). Here, language-specific PFs could account for the language-specificity of lexical items without the division of the Lexicon: *a syntactic head H is part of the language L if some VI of L targets H*. Since VIs are part of PF, they would already be language-specific by virtue of the division of PFs (assumed by hypothesis for now).

A further case for reducing linguistic division to PF can be based on theoretical parsimony. If we begin with the assumption that both the Lexicon and PF are divided between languages, the following can be demonstrated: for a language L, *membership in the L-Lexicon is always expected to go together with pronounceability via the L-PF*. Consider the four logical options concerning the status of a head H with respect to two properties: (i) presence in the L-Lexicon, and (ii) pronounceability in L by virtue of the L-PF. In the unproblematic case, H is both present in the Lexicon and pronounceable. If it is neither, the derivation crashes. The relevant question now is whether (i) and (ii) could diverge.

First, consider the possibility that H is absent from the L-Lexicon but can be pronounced via the L-PF. Theoretically, H not belonging to the L-Lexicon could either cause the derivation to crash or it might not have such an effect. In the former case, the derivation would crash prior to PF and hence its pronounceability via the L-PF could not be evaluated in the first place. In the latter case, H would reach the L-PF that could (by hypothesis) produce its PHON – exactly as if H belonged to the L-Lexicon.

Second, consider the option that H was present in the L-Lexicon but could not be pronounced via the L-PF. In this case, any derivation containing H would crash at PF. There would thus be no grammatical expression in L that included H, and hence no evidence for allocating H to the L-Lexicon in the first place.

In summary, even if both the Lexicon and PF were differentiated to language-specific compartments, presence in the L-Lexicon and pronounceability via the L-PF are always expected to go together in any bilingual I-language. Evidence needed for their dissociation would always be equivalent with evidence for a simpler alternative hypothesis where they are aligned: either H is in the L-Lexicon and can be pronounced via the L-PF, or neither. This invites simplifying the theory by unifying the Lexicon: since the presence of H in the L-Lexicon can be predicted from its pronounceability via the L-PF, it is possible to reduce its language-specificity to the L-PF alone without losing any relevant information. The "L-Lexicon" is simply the subset of the (uniform) Lexicon that is targeted by the L-PF.

López (2020) goes even further in the unification of bilingual I-language, proposing that *neither* the Lexicon not PF are language-specific. His analysis builds on the notion that PF-rules apply to specific SOs, and possible competition between rules that apply for the same SO are resolved by the Subset Principle (see Section 3.1.8). As long as the competition can be resolved, the rules are compatible within the same I-language. López' argument relies on the observation that assuming the language-specificity of PF makes different predictions than assuming a language-uniform PF concerning rules that apply to the same SO but are not orderd by the Subset Principle. A uniform PF would allow free variation between such rules, whereas a divided PF would ban this as illegitimate PF-internal code switching.

López provides evidence for PF-level code switching between language pairs including Spanish-Basque, Spanish-German, and Spanish-Catalan. For example, the dative third person clitic is subject to an improverishment rule in both Spanish and Catalan when it preceeds an accusative third person clitic. In Spanish the dative clitic gets the unmarked default form *se*, whereas in Catalan the clitic cluster is simplified into a single form *l'hi*. Examples are shown in (33), with the clitics in bold and the clitic cluster in square brackets.

(33) a. Pedro [**le** **lo**] dijo ⇒ Pedro [**se lo**] dijo
Pedro 3.DAT 3.ACC say.PAST
'Pedro said it to him' (Spanish)

b. El Pere [**li** **ho**] va dir ⇒ El Pere [**l'hi**] va dir
the Pere 3.DAT 3.NEUT.ACC PAST say
'Pere said it to him' (Catalan)

(modified from López 2020: 118–119)

López then presents examples (34a–c), which apply the Spanish impoverishment rule in (colloquial) Catalan.

(34) a. El Pere [**s' ho**] va dir
the Pere SE 3.NEUT.ACC PAST say
'Pere said it to him'

b. [**Se' l**] vaig enviar juntament amb les fotografies
SE 3.MASC.ACC PAST.1 send.INF together with DEF photograph.PL
'I sent it to him/her together with the photographs'

c. [**Se la**] vaig donar fa tres o quatre dies
SE 3.FEM.ACC PAST.1 give.INF do.3 three or four day.PL
'I gave it to her/him three or four days ago'

(modified from López 2020: 119)

Since impoverishment – as a morphophonological rule – belongs to PF, examples (34a–c) instantiate PF-level code switching, which would be banned if PF was strictly language-specific. López (2020: 122–124) further reports similar cases for linearization and prosodic stress assignment. This indicates that code switching could in principle be freely available, both at NS and PF. He explains restrictions against code switching via the syntactic conditioning of PF-rules, where PF-rules are grouped together based on the syntactic properties they target. "English" PF-rules target "English" syntactic heads/features, "Finnish" PF-rules target "Finnish" heads/features, etc. (where the language names are purely metatheoretical).

However, while López' data illustrates PF-level code switching in certain cases, it is unclear whether linguistic differentiation could be fully accounted for without assuming *any* language-specific PF-rules. One challenge arises from PF-rules that are clearly language-specific but cannot be readily connected by the syntactic features they target. An example is Finnish vowel harmony, where suffixes are realized with either front or back vowels depending on the vowels of the root they attach to. As shown in (35a–d), vowel harmony applies across e.g. case, person- and number agreement, causativity, and participial suffixes.

(35) a. tuoli-lla pöydä-llä
chair-ADE table-ADE

b. juo-vat syö-vät
drink-PRES.3PL eat-PRES.3PL

c. naura-ttaa viihdy-ttää
laugh-CAUS entertain-CAUS

d. juos-sut kävel-lyt
run-PCP.PAST walk-PCP.PAST

The vowel harmony rule is connected to other aspects of the Finnish PF, such as [nk] manifesting as [ŋ] (spelled *ng* in Finnish orthography) in final syllables of roots when preceding a suffix-initial consonant. This is shown in (36a–b) with the inessive case suffix *-ssA*:

(36) a. lanka langa-ssa
thread thread-INE

b. kenkä kengä-ssä
shoe shoe-INE

The two PF-rules are reliably used together when both apply to the same expression: the case suffix uses the back vowel in (36a) and the front vowel in (36b). However, since the rules apply generically to a wide range of morphemes, they are difficult to assign to Finnish-specific functional structure. Rather, it seems that they must somehow be *parts of the same network* of Finnish PF-rules. These observations suggests the need to combine López' (2020) unified analysis with the possibility of at least some language-specificity within PF. To achieve this, I suggest that the language-specificity should be analyzed via *groups of mutually compatible PF-rules*. This also covers López' proposal as a special case, where *all* PF-rules are compatible.

Specifically, I make the assumption that PF-rules are connected to each other by *links* that can take positive or negative values. Positively connected PF-rules are *compatible*, and can be freely combined. Negatively connected PF-rules are *incompatible*, and their co-occurrence causes the derivation to crash at PF. Compatibility allows resolving competition between PF-rules when the Subset Principle does not suffice.

Competition between VIs occurs when they apply to the same SO, and is typically resolved by the Subset Principle, where the most informative VI is selected. In Section 3.1.8, this was illustrated for English plural marking in example (19) derived from Embick (2015: 93), repeated below as (37):

(37) a. T[+past] $\leftrightarrow$ -t / $\{\sqrt{bend}, \sqrt{leave}, ...\}$ _

b. T[+past] $\leftrightarrow$ -∅ / $\{\sqrt{hit}, \sqrt{quit}, ...\}$ _

c. T[+past] $\leftrightarrow$ -ed

The last condition (37c) is the least specific *elsewhere*-rule, which only applies if the more specific constraints set by (37a–b) are not fulfilled. Therefore the past form of e.g. *bend* is *bent* and not *bended* despite both (37a) and (37c) applying to it: the Subset Principle selects (37a) as the more informative rule.

Consider, now, a case where two VIs compete but apply to *identical* features, as in (38):

(38) a. [+plural] $\leftrightarrow$ -t

b. [+plural] $\leftrightarrow$ -s

In (38), both VIs are elsewhere-rules for the plural feature. Therefore, their competition cannot be resolved by the Subset Principle. Nevertheless, both are VIs of plural suffixes: (38a) in Finnish and (38b) in English, respectively. A Finnish-English bilingual thus needs both. I suggest the rules are both present at PF, but are *incompatible* – i.e. negatively linked – due to the irresolvability of their competition.

The two plural VIs (38a–b) are also linked to other language-specific PF-rules, which makes (38a) a part of "Finnish" and (38b) a part of "English". This can be analyzed as one subset of PF-rules being positively connected to (38a), and another subset being positively connected to (38b). Conversely, these subsets of mutually compatible PF-rules constitute the "languages" in question, on the level of PF.

Consequently, a language-specific PF can now be reanalyzed as a *maximal group of mutually compatible PF-rules*. Being such a group requires (i) that each of its rules is positively connected to each of its other rules (mutual compatibility), and (ii) that it is not a proper subset of any larger group of mutually compatible PF-rules (maximality). With 10 PF-rules, Figure 3.6 shows their grouping into clusters, where a line connecting two rules indicates a positive connection (i.e. compatibility), and the lack of a connecting line indicates a negative connection (i.e. incompatibility). There are two maximal clusters of mutually compatible rules, and two of the rules R1–R10 are shared between these: R5 and R6. Hence, R1–R6 and R5–R10 constitute the largest groups of mutually compatible PF-rules. These are the PFs of two "languages" L1 and L2.

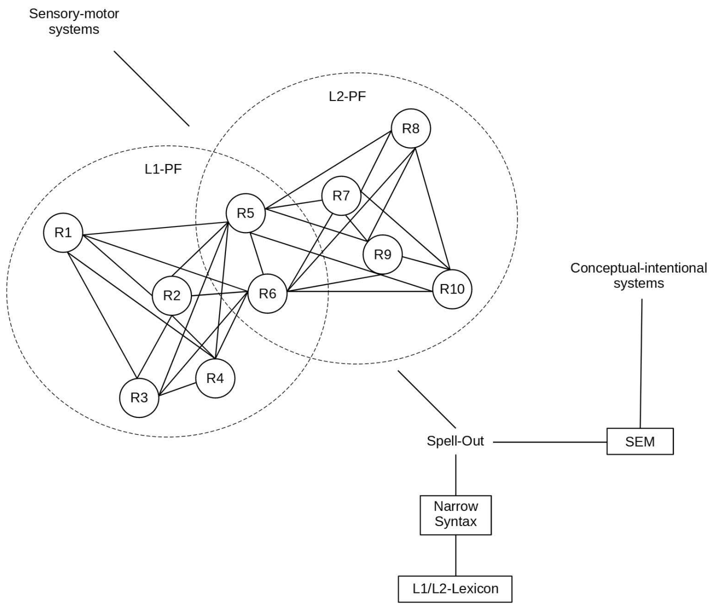


Figure 3.6: Clustering of PF into groups of mutually compatible rules.

As rules R5–R6 in Figure 3.6 show, the present framework allows PF-rules to be *shared* between languages. This helps to account for the gradual shift from a "style" through a "dialect" to a "language", within the I-language perspective. Stylistic variation can occur when two incompatible PF-rules are both compatible with other rules used in the derivation, and hence the choice between them is not grammatically restricted. For example, written Finnish uses largely different pronouns than (certain variants of) spoken Finnish: e.g. the distal demonstrative is *tuo* in written Finnish but *toi* in (certain variants of) spoken Finnish. However, while the allocation of each expression to written or spoken Finnish is relatively clear in pragmatic terms, spoken Finnish is lenient with allowing either form. Therefore, at least for many Finnish speakers, rules (39a–b) are both available in the same grammatical contexts in spoken language, and the choice between them allows stylistic variation.

(39) a. [+dem +distal] $\leftrightarrow$ tuo

b. [+dem +distal] $\leftrightarrow$ toi

Rules (39a) and (39b) compete, and the Subset Principle cannot resolve this, which makes them incompatible. However, it is still possible for both to be compatible with largely the same rules, which effectively results in the optional choice between (39a) and (39b) when the distal demonstrative is present in NS. This choice is made on some other basis than strict grammaticality, such as stylistic appropriateness from a broader pragmatic perspective. This analysis fits well with Roeper's (1999) account of optionality as a consequence of "bilingualism"; i.e. the presence of multiple grammatical systems in the same I-language, which is ubiquitous even across speakers typically considered "monolingual".

Other aspects of Finnish are clearer in terms of the spoken-written distinction, such as verb agreement. For example, the first-person plural subject agreement is (40a) in written Finnish but (40b) in spoken Finnish.

(40) a. V[+3PL] $\leftrightarrow$ -mme
b. V[+3PL] $\leftrightarrow$ -AAn[37]

Such VIs for the same elements are divided between "spoken Finnish" and "written Finnish" PF-rules. However, these groups still share a vast array of rules, and are thus largely overlapping. For this reason, they can be considered "dialects". In contrast, mostly non-overlapping maximal groups of mutually compatible PF-rules can be considered "languages" rather than "dialects" due to their reliance on mostly separate and incompatible rules. An example of this would be Finnish and English PF-rules, as discussed above. Importantly, there are no strict boundaries between styles, dialects, and languages (within I-language); these emerge from the underlying links between PF-rules, which can form more or less overlapping maximal sets of mutually compatible rules.

López (2020) analysis can be incorporated into the present approach as a special case, where *all PF-rules are mutually compatible*. If PF is modelled as a network of positively or negatively connected rules, it is divided between languages(/dialects) if at least some rules are incompatible. Since the Subset Principle allows competing VIs to coexist, López' claim that each putative case of irresolvable competition could be resolved by the Subset Principle allows the possibility that the connection between each PF-rule pair could be positive. While I do not assume this, an important benefit of the present approach is that it does not directly contradict López, but instead treats his analysis as one (extreme) possibility.

I have deviated from the traditional "box" notation for different PF-clusters, where each PF-rule is allocated to a separate compartment (as in Figure 3.5). However, my approach is also compatible with such an alternative: whether the positive links between compatible PF-rules are facilitated by them being "stored" in dedicated compartments or in some other way

[37] The suffix vowel "A" manifests either as a back-vowel (/a/) or a front vowel (/ae/) depending on the final vowel of the verb root. This illustrates the Finnish vowel harmony rule discussed above.

remains an open question. I remain agnostic on how PF-rules actually *receive* and *maintain* their negative or positive links; I only propose that such links exist. One way they could be implemented would be via PF-rules being divided into different compartments (allowing overlap), which would facilitate positive links between rules that belong to the same compartment and negative links between other rules. Another way to realize the links would be that they are maintained directly between individual rules in PF, where "language-compartments" are emergent phenomena arising from the network of links in a bottom-up manner. The former view is more in line with standard Minimalist and DM approaches to bilingualism (e.g. MacSwan 1999, Grimstad et al. 2014), whereas the latter fits better with proposals that aim to reduce modularity within I-language in favor of more dynamic and network-based frameworks (e.g. Höder 2014, Putnam et al. 2018). While the debate between such alternatives is an important aspect of ongoing research, commitment to either variant is not necessary here.[38]

In short, I only propose the following three claims: (i) PF-rules are connected via positive or negative links; (ii) negatively connected PF-rules are incompatible – i.e. their co-occurrence causes the derivation to crash at PF; and (iii) positively connected PF-rules are compatible – i.e. their free combination is allowed. A bilingual I-language contains (at least) two maximal groups of mutually compatible PF-rules, which constitute the PFs of two "languages".

3.3.4 Revisiting variation within the PF-based analysis of bilingualism

I now briefly review how the loci of linguistic variation listed in Table 3.3 (Section 3.2.6) can be analyzed within the PF-based account of language differentiation.

Presence of syntactic heads/features. The presence of a syntactic head in language L can be equivocated with its pronounceability via the L-PF. The presence of a feature F in L arises from some head(s) containing F being targeted at the L-PF.

Movement. If movement is accounted by feature strength (Section 3.2.2), it falls under variation in syntactic features: a weak feature being targeted by the L-PF results in movement at NS. The same principle can account for EPP-driven movement, if the EPP is considered a lex-

[38] Another important aspect of future work is combining the present hypothesis with prior work on bilingual language acquisition (e.g. White 2003, Yang 2018, Slabakova et al. 2020), general computational models of language acquisition (e.g. Yang 2002, 2016, Lidz and Gagliardi 2015), and data-driven learning algorithms such as *Hebbian learning* (Hebb 1949, Choe 2014). The Hebbian principle maintains that the connection between two nodes of a network is increased if the nodes are co-activated. This is likely relevant for acquiring the connections between PF-rules: two rules must be compatible to be used *together* for deriving a PHON.

ical feature. Alternatively, if the EPP is a PF-level phenomenon, its variation is located to PF as well. If seeming variation in movement arises from whether the original or target position of the movement is pronounced (Bobaljik 2002), this also concerns PF.

Agreement/case. If agreement and case are post-syntactic phenomena, their variation trivially concerns PF. If they are accounted for by the syntactic process of feature checking or valuation (see Section 3.2.3), their variation concerns the presence of syntactic features.[39] The same is true if they are assigned by separate functional heads (e.g. K).

Word/morpheme-order. Variation in the linear order between words or morphemes arises from two possible sources: *Linearization* and *movement*. If variation in the Linearization algorithm is possible, it resides at PF. Variation in movement was discussed above.

(Morpho)phonology. This locus of variation resides at PF by definition.

Summary. The sources of variation located to the Lexicon or PF in Table 3.3 can be retained even if language differentiation is PF-based. Hence, the main idea behind the Borer-Chomsky conjecture is not threatened by the rejection language-specific Lexicons.

3.3.5 Priming and "language modes"

The notion of *language mode* has been prevalent in the cognitive psychology literature on bilingualism (Grosjean 1982, 1998, 2001, Marian and Spivey 2003, Dunn and Fox Tree 2014, Yu and Schwieter 2018). Grosjean (2001) characterizes a language mode as "the state of activation of the bilingual's languages and language processing mechanisms" (p. 3), which can vary dynamically based on context. I suggest that the PF-based framework on language-differentiation presented in Section 3.3.3 can incorporate this idea.

Priming is a central effect of spreading activation across memory networks that has been extensively documented in language processing (e.g. Neely 1977, Anderson 1983, Stanovich and West 1983, Farrell et al. 2012). For present purposes, it can be characterized as the activation of some part of a network systematically increasing the activation of another part. I propose that "language modes" arise from the priming between linguistic units, facilitated by the language-differentiation within PF.

[39] Accommodating the feature checking approach to PF-based language differentiation might initially seem problematic, since uninterpreted features are supposed to be *deleted* via checking (Chomsky 1995a). However, given that elements appear with different PHONs based on their agreement relations, there needs to be some way in which uninterpretable features are detected at PF in any case.

In particular, I make the following hypotheses: (i) positively connected PF-rules prime each other; and (ii) SOs prime their interface-interpretations (PHONs and SEMs) and vice versa. The first is a straight-forward extension of the idea that PF-rules form networks via positive or negative links (Section 3.3.3). The second can be justified by the Hebbian principle that (*ceteris paribus*) when two units are systematically co-activated, their associative connection increases (Hebb 1949). For instance, applying the VI of a syntactic head H at Vocabulary Insertion requires co-activating H and its PHON (see Section 3.1.8), which increases the mutual priming between them. The corresponding principle applies between H and its SEM. Consequently, the SEM and PHON are also co-activated (assuming Spell-Out to be simultaneous for both, at least often) and will thereby prime each other.

Putting the two hypotheses together yields the prediction that mutually compatible PF-rules prime each other, and consequently prime each part of the syntactic derivation that involves them. The spread of this priming brings about the “language mode” of the language identified by the maximal group of compatible PF-rules. For example, an English-Finnish bilingual enters the “English mode” upon the activation of a group of English PF-rules, which in turn will prime other English PF-rules along with the SOs they target and consequently their SEMs. Importantly, language modes are aspects of *performance*, not competence (see Chapter 2, Section 2.1), and therefore do not constrain the syntactic derivation as such.

Language modes have been divided into three main types in prior literature: a *monolingual mode* where only one language is active, an *intermediate mode* where a second language is active but clearly less so than the primary one, and a *bilingual mode* where two languages are co-activated, which can manifest as e.g. code-switching (Grosjean 2001, Yu and Schwieter 2018). This idea can be appended based on the hypothesis that languages are differentiated at PF. In particular, PF-rules shared between both languages are expected to be primed the most in intermediate and bilingual language modes. For example, if an English-Finnish bilingual is translating from English to Finnish and thus must activate both languages, those PF-rules than are common to both languages should be primed more than language-specific PF-rules of either language. Consequently, SOs connected to those PF-rules (and hence their SEMs) will also be primed more than language-specific ones. This prediction is corroborated by empirical evidence on priming effects in translation (Jiang 2015, Wen and van Heuven 2017, Lee et al. 2018) as well as *translation universals* (Baker 1993, Laviosa-Braithwaite 2001, Malmkjaer 2011); the latter being covered in Chapter 5 (Section 5.3).

3.4 Summary

This chapter has presented the linguistic framework used in the remainder of this dissertation (Sections 3.1–3.2), and an analysis of language differentiation within bilingual I-language based on the grouping of PF-rules (Section 3.3). I follow mainstream Minimalism with respect to the basic architecture of I-language and NS-operations (Sections 3.1.1–3.1.4). I further adopt DM's treatment of *roots*, *categorizers*, and *functional heads* (Section 3.1.5–3.1.6) as well as *Late Insertion* at PF (Section 3.1.8). Finally, I incorporate *extended projections* and *syntactic domains* (Section 3.1.7).

The present framework predicts the following universal properties for any I-language: (i) the Y-model architecture; (ii) the basic NS-operations; (iii) the taxonomy of roots, categorizers, and functional heads; and (iv) the allocation of functional heads to three syntactic domains in extended projections. All other aspects are, at least potentially, open to variation. Specifically, the sources of variation were argued to be: (i) the presence of syntactic heads/features, (ii) movement, (iii) agreement/case, (iv) word/morpheme order, and (v) (morpho)phonology. Each of these can be located to the Lexicon or PF (Section 3.2.6).

A common Minimalist conception of bilingualism has been that bilinguals have two Lexicons and two PFs, which are somehow linked (Section 3.3.2). Against this, I argued that stipulating separate Lexicons is both theoretically superfluous and empirically problematic. As an alternative, I proposed that "languages" within a bilingual I-language are *maximal groups of mutually compatible PF-rules*, where each PF-rule is positively or negatively linked to others (Section 3.3.3). A bilingual I-language contains at least some negatively connected PF-rules, and hence more than one such maximal group. Notably, while language differentiation is ultimately confined to PF, its manifestation indirectly covers the whole Y-model from the Lexicon to both interface-interpretations.

While the framework shuns "language nodes/tags/features" (Section 3.3.3), it allows reformulating the notion of *language mode* used in the cognitive psychology of bilingualism (Section 3.3.5). This can be analyzed as arising from *priming* relations between positively linked PF-rules, SOs, PHONs, and SEMs. For translation, this account predicts that *shared* aspects of the source and target language should be primed more than language-specific aspects of either. I return to this topic in Chapter 5 (Section 5.3).

Chapter 4

Concepts and the syntax-semantics interface

Concepts provide the constituents of propositional thought, and are linked to language via the syntax-semantics interface.[1] Since translation is a quintessentially semantic process, understanding the nature of concepts and their relation to language(s) is integral for its proper analysis. There is a vast range of theories of concepts across different fields (for overviews, see e.g. Peacocke 1992, Fodor 1998, Laurence and Margolis 1999, 2003, Murphy 2002, Machery 2009, Carey 2009, Fodor and Pylyshyn 2014). In this chapter I provide an overview of the central questions regarding the nature of concepts with a focus on cognitive science and linguistics, and defend a position that takes concepts to be (typed) atomic *pointers* to pluralistic information (Quilty-Dunn 2020). I further combine this with the *conjunctivist* account of the syntax-semantics interface, as developed by Pietroski (2005a, 2008, 2011, 2018).

Section 4.1 reviews the main *desiderata* for a theory of concepts within cognitive science and linguistics, and provides a brief critical survey of prominent views proposed in prior literature. Section 4.2 discusses conceptual atomism in more detail, and presents the pointer-based analysis adopted in this dissertation. Section 4.3 discusses the syntax-semantics interface and SEMs, combining the conjunctivist account with the linguistic framework of Chapter 3.

[1] Since I adopt the DM viewpoint that discards the syntax-morphology distinction prior to Spell-Out, the "syntax-semantics interface" is assimilated to the grammar-semantics interface in general (see Chapter 3).

4.1 Overview of prominent theories of concepts

Multiple notions of "concept" are used across different fields, and these do not always converge. Section 4.1.1 teases apart distinct uses of the term in prior literature, and specifies the sense applied in this dissertation. Sections 4.1.2–4.1.5 review leading candidates for a cognitive theory of concepts (excluding conceptual atomism), concluding that none are satisfactory.

4.1.1 Concepts as aspects of cognition

A major distinction can be drawn between the philosophical use of the word "concept" to denote some kind of an abstract entity separate from any cognitive systems, and the psychological/cognitive use that takes "concepts" to be aspects of cognition used in the classification of perceptual data, making categorical judgements, inference, and a range of other tasks (Laurence and Margolis 1999, 2003, Machery 2009). I use the term in the *latter* sense, and denote concepts with small capital letters (DOG, CAT, etc.).[2]

Concepts are commonly taken to specify *referential contents* – i.e. mind-external entities or properties they are "about". However, *Frege cases* illustrate that referential content does not exhaust a concept's contribution to thought. Frege's (1896/1952) own examples include MORNING STAR and EVENING STAR, which are distinct concepts with the same referent: the planet Venus. Even though they are coreferential, it is possible to utilize one but not the other in thinking about Venus. Despite Frege's (1884/1934) own opposition to treating concepts as an aspect of psychology,[3] Frege cases have important ramifications for cognitive science: they illustrate the distinction between thinking *of* something on the one hand, and thinking of something *as* something on the other hand (Fodor and Pylyshyn 1981). Whether I think of Venus *as* MORNING STAR or *as* EVENING STAR is determined by which concept I apply.

Another crucial aspect of concepts is that they can be *combined* to construct complex concepts *compositionally* based on the constituent concepts and their *mode of combination*. For example, the complex concept BROWN DOG is constructed from BROWN and DOG via con-

[2] As parts of each speaker's cognition, concepts are speaker-specific. This might seem to contrast with the seeming *publicity* of concepts – i.e. their ability to be *shared* between people. However, this is compatible with the present view, provided that the shared "concepts" are taken to be *types* that are *tokened* in each speaker (Fodor 1998: 28). For example, to say that both John and Mary have the concept DOG is to say that they have their own concept-tokens, both of which fall under the concept type DOG.

[3] For an illuminating history of debates about "psychologism" in the 20th century, see Kusch (1995).

junction. Compositionality is central to the *productivity* of conceptual thought: the ability to formulate indefinitely many novel complex concepts from a finite set of atomic concepts and modes of combination. A related notion is *systematicity*, where certain cognitive abilities reliably co-occur with others by virtue of shared structural relations. For instance, understanding JOHN SAW MARY entails understanding MARY SAW JOHN, and vice versa. This is because both are based on recognizing the same constituents and the same mode of combination, albeit applied in different orders (Fodor and Pylyshyn 1988).[4]

The brief exposition above illustrates three main properties of concepts most relevant for present purposes. First, they are parts of the cognitive architecture used across numerous tasks, such as classification, inference, and the semantic interpretation of language. Second, they determine what property something is thought of *as* instantiating, illustrated by Frege cases. Third, they can be compositionally combined into complex concepts. Sections 4.1.2–4.1.4 argue that many prominent theories have trouble accounting for the *combination* of these properties. Despite this, Section 4.1.5 opposes eliminating the notion of "concept", maintaining that it is needed to account for central aspects of cognition.

4.1.2 Definitional theories

The *definitional* (or "classical") view treats most concepts as combinations of others via some connectives. This requires a finite set of conceptual primitives to ultimately underlie all concepts, and was championed by classical empiricists such as Locke (1690/1975) and Hume (1739/2000). Here, the defining constituents were sensory qualities like colour, shape, or sound. Nativist varieties of definitionalism – most elaborately outlined by Katz and Fodor (1963) – treat the atoms of conceptual combination as non-empirical abstract categories specified by the innate make-up of human cognition.

The demise of definitionalism has mainly resulted from the lack of practically any satisfactory contenders for definitions (Fodor et al. 1980). As an attempt, consider (41) as a suggested definition of CHAIR from Katz (1972: 40; notation changed to fit mine):

(41) OBJECT, PHYSICAL, NON-LIVING, ARTIFACT, FURNITURE, PORTABLE,
SOMETHING WITH LEGS, SOMETHING WITH A BACK,
SOMETHING WITH A SEAT, SEAT FOR ONE

[4] On systematicity, see also Aizawa (2003), McLaughlin (2009), and Calvo and Symons (ed.) (2014).

It is easy to find counter-examples to the proposed definition: not all chairs have a back or legs, some fit more than one person, etc. Furthermore, if CHAIR was literally constituted by the concepts listed in (41), this would mean that a child could not acquire CHAIR prior to those. This is highly unlikely: abstract concepts like PHYSICAL, NON-LIVING, and ARTIFACT are regularly used later than *basic-level* concepts such as CHAIR (Rosch 1973, Rosch et al. 1976, Bloom 2002). It thus seems that CHAIR can be available in the absence of at least some of its putative constituents in (41).

A residue of nativist definitionalism has remained in various hypotheses that *some* abstract concepts might still be innate conceptual primitives, such as those denoting basic ontological categories (e.g. OBJECT, EVENT), thematic roles (AGENT, THEME), number, tense, modality, logical connectives, quantifiers etc. (e.g. Jackendoff 1983, 1990, Spelke 2000, Pinker 2007, Carey 2009). Such views are sometimes called *neo-classical* (Leben 2015), since they accept the existence of innate conceptual constituents and at least some decomposability, without requiring the innate constituents to provide definitions.[5]

4.1.3 Prototype theories

Perhaps the most influential non-definitional empiricist account of concepts is the *prototype theory*, where judgements of membership in the extension of the concept follow from proximity to a prototype, which can be thought of either as a typical exemplar or as a mean of typical properties (Rosch 1973, 1975, Churchland 1998, Barsalou 1999, Gärdenfors 2000, 2014, Prinz 2002). The prototype does not need to contain either necessary or sufficient conditions, and can be dynamically modified when new knowledge is acquired. Another central aspect of prototype theory is the application of Wittgenstein's (1953) notion of *family resemblance*, where each member of a category is similar to other members in some respects, but no unified set of properties needs to be shared across all members.

Despite its popularity in cognitive psychology, prototype theory has been subjected to criticism. Below, I raise six major problems with the theory. I maintain that these provide a cumulative case against prototypes being *constitutive* of concepts.

[5] Similarly, Katz (2004) held that meanings, while decomposable, do *not* determine reference. This opens up the possibility that a concept might be decomposable without that decomposition determining the "essence" of the referent. On the relationship between meaning and reference-determination from different semantic perspectives, see e.g. Farkas (2006).

Lack of prototypes. Many concepts do not have clear prototypes. These include abstract concepts (DEMOCRACY, IDEA), highly specific concepts (THE THIRD PERSON WHO DRANK COFFEE AFTER 11AM TODAY), as well as complex concepts formed by Boolean operators: CAT might have a prototype but NOT A CAT does not (Fodor 1998: 101–102).

Unconstitutive prototypes. Some concepts have prototypes even if they are manifestly not constitutive of the concept. For example, Armstrong et al. (1983) report prototypicality effects for ODD NUMBER, which is a quintessentially sharp, non-fuzzy concept. Even if 5 is a more prototypical odd number than 253889, both are *equally correct* instances.

Unreliability of prototypicality. Something that fits the prototype of a concept is not necessarily judged to be an instance of the concept. The saying 'if it looks/quacks/swims/... like a duck, it is probably a duck' is appropriate if the inference is considered an abductive inference to a likely conclusion, but fails if it is considered strictly necessary. It is readily possible to entertain a concept such as IMPOSTOR DUCK: something that satisfies the prototypicality condition but fails to be an instance of the concept. Accounting for this possibility is difficult for the prototype theory, as it assimilates the concept to the prototype or some proximity metric to it (Laurence and Margolis 1999: 56).

Atypical cases. It is not clear how the prototype theory can analyze instances that are not prototypical (Armstrong et al. 1983, Laurence and Margolis 1999). If the concept's identity is literally treated as (proximity to) the prototype, atypical cases would be conceptually impossible. If CAT is logically equivalent to (proximity to) the CAT-prototype, UNPROTOTYPICAL CAT would be conceptually contradictory, which it evidently is not.

Judgements of sharp boundaries. While people make fuzzy judgements on many categories, this is not a reliable indicator of whether they judge the category to actually have sharp boundaries. Armstrong et al. (1983) report discrepancies between such tasks: for example, if asked whether FRUIT is a graded or all-or-nothing category, test subjects reliably replied the *latter* despite also making graded prototypicality judgements about fruits. As Laurence and Margolis (1999) note, "prototypes needn't involve a commitment to graded membership" (p. 33). Graded or non-graded status is a central aspect of a concept, but is not reliably tracked by prototypicality effects.

Compositionality. Complex concepts are *composed* of other concepts even if their prototypes are not similarly composed. Fodor (1998: 102) provides the example of PET FISH, which is compositionally constituted by PET, FISH, and their mode of combination (conjunction). Unlike the concept, the prototype of a pet fish (e.g. a goldfish) is *not* constituted by the prototype of a pet (e.g. a dog or cat) and the prototype of a fish (e.g. a trout). Even if some prototypes could be composed (Schrutz 2012, Prinz 2012), this discrepancy illustrates that concepts and prototypes should not be fully assimilated.

Summary. Overall, the arguments reviewed above suggest that concepts *have* prototypes instead of *being* prototypes (Armstrong et al. 1983, Rey 1983, Fodor 1998, Laurence and Margolis 1999, Connolly et al. 2007). Some other means are needed to individuate concepts, which can then be linked to prototypes among other non-constitutive information.[6]

4.1.4 Conceptual role theories

The main alternative to concept empiricism has been the large variety of *conceptual role* theories. Here, a concept's identity is fixed by its place in the network of beliefs, habits etc. that are held either by an individual or a larger group. Especially the influence of Wittgenstein (1953) and Quine (1951, 1960) has been extensive in making conceptual role semantics a leading view among philosophers of language, particularily as a non-nativist alternative to pure empiricism (e.g. Block 1986, Peacocke 1992). In cognitive psychology, *knowledge-based* views of concepts (sometimes called *theory-theories*) exemplify the conceptual role approach (Gopnik and Meltzoff 1997, Carey 2009).

Conceptual role semantics offers an intriguing alternative to prototype and exemplar theories, which could avoid the pitfalls of both empiricism and nativism about concepts. A challenge for this approach is to differentiate those roles that are *constitutive* of the concept from those that are not. This invites the *analytic-synthetic distinction*, which has been problematic especially since observations made by Quine (1951). As discussed in Section 4.1.2, it is difficult to glean which conceptual roles are definitional of the concept (i.e. analytic) and which are aspects of "world-knowledge" that may be relevant to the concept but are not among its constitutive features (Fodor et al. 1980).

[6]The *exemplar theory* assimilates a concept with the set of its memorized instances (Medin and Schaffer 1978, Smith and Medin 1999). Initially, it could more easily incorporate concepts that lack a prototype, atypical cases, and other discrepancies between prototypicality and conceptual identity. However, it cannot provide a sufficient non-circular analysis of concepts, since the information stored about categories and their exemplars is itself conceptual. Instead of explaining what concepts are, the exemplar theory can be more fruitfully analyzed as concerning the classification of novel exemplars to concepts *given* that those concepts already exist and have exemplars describable with *conceptual* information (see also Murphy 2016).

Given the general lack of definitions, a common consequence of conceptual role semantics has been *holism*, where the concept is constituted by *all* relations it bears to other concepts, other aspects of cognition, behavior, society, etc. (Wittgenstein 1953, Quine 1951, 1960, Rorty 1979, Brandom 1994, Horwich 1998). However, an influential criticism of such conceptual holism has been that it cannot maintain the *stability* of concepts across changes in the conceptual system (Fodor and Lepore 1992).

Suppose I first believe that dolphins are fish and subsequently adopt the belief that they are not. Since my concepts DOLPHIN and FISH are related in one way at the beginning, holism entails that this relation partly constitutes their identities. Any concepts related in a different way would *ipso facto* not be them. Hence, whatever I learn when I come to believe that dolphins are not fish, it cannot relate *these* concepts in a new way; it can only introduce *novel* concepts. If at time t_1 I hold the belief $\text{DOLPHIN}_1 \rightarrow \text{FISH}_1$ and at time t_2 come to believe that dolphins are not fish, the latter should be formalized as $\text{DOLPHIN}_2 \rightarrow \neg\text{FISH}_2$. Instead of *updating* DOLPHIN_1 and FISH_1, I have *replaced* them with DOLPHIN_2 and FISH_2. Holism thus makes it impossible to maintain any distinction between updating beliefs formulated with pre-existing concepts and acquiring wholly new concepts: every change to the conceptual system alters the identities of all concepts in it.[7]

One possibility could be to bite the bullet and accept that concepts do not maintain their identity across changes to their roles. Perhaps it suffices that the old and new concept are *highly similar* (e.g. Harman 1973, Block 1986). However, as Fodor and Lepore (1992) note, the notion of similarity only makes sense in light of some basis of evaluation, which in the present case are other concepts. If each concept changes its identity after any change to the system, then *all* concepts change their identities, removing the basis of evaluating (dis)similarity. Instead, holism entails the *incommensurability* between the conceptual system before and after the change. They form different "paradigms" in the sense of Kuhn (1962), and no meaningful comparison is any longer available.

Developments in the philosophy of language have also undermined conceptual role theories. Putnam (1975) notes that people often understand terms as being distinct in meaning even if they lack the knowledge on what the distinguishing features of their referents are. He

[7]The mere retention of the same word is insufficient: *polysemy* and *homonymy* demonstrate that grammatically or phonologically identical words can be used for distinct concepts. This is especially clear for concepts of individuals: two different people can have the same name, and a single person can be conceptualized in different ways even when retaining the name (c.f. Kripke 1979). See Section 4.1.5 for further discussion.

provides the examples of ELM and BEECH: many people cannot tell elms and beeches apart but nevertheless know them to be different. Kripke (1980) makes related observations about proper names. Even if a description was the common means by which we recognize a person – such as Gödel being the person who coined the incompleteness theorem – we do not consider such descriptive information to be *necessary* for the person's identity: it is readily conceivable that Gödel might not have coined the theorem. Such considerations suggest against equivocating concepts with descriptions; i.e. relations to other concepts.[8]

4.1.5 Pluralist and eliminative theories

A possible response to the challenges presented in Sections 4.1.2–4.1.4 would be to deny the existence of concepts in the sense outlined in Section 4.1.1. Such a view could be considered *pluralist* in allowing many kinds of "concepts" without unifying them into a single class, or *eliminativist* in removing the term from the theoretical vocabulary altogether.

Machery (2009) suggests that "concept" is not a *natural kind*: there is no identifiable entity or property that serves all the tasks that concepts should be responsible for.[9] Prototypes, exemplars, theories, etc. can diverge and do not come together into a unified concept. Rather than making a holistic network, they are partly separable aspects of the cognitive architecture, which allows retaining some of them even if others change. For example, a prototype can remain the same even across updates to theoretical beliefs.

A challenge for the pluralistic view is that conceptual judgements concern the *same* properties even when using different information. Suppose I first believe that all swans are white, then see a black bird of which someone (who I trust) states *That is a swan*, and as a consequence change my belief. Why is my belief impacted by the perception and the linguistic utterance? A plausible reason is that their interpretation involves the *same* concept SWAN. If three distinct "concepts" were used in belief formation, perceptual categorization, and interpreting linguistic utterances, their systematic mutual interactions of this kind would remain inscrutable.

[8] The Kripkean tradition in the philosophy of language has generally not concerned the cognitive science of concepts, but has instead adopted an *externalist* approach to semantics with a metaphysical focus (see e.g. Hughes 2004). Nevertheless, it has indirectly advanced research on more cognitively oriented matters, such as *psychological essentialism* (Medin and Ortony 1989, Gelman 2003, 2004, Newman and Knobe 2019), and the *mental files* approach to proper names (Recanati 2012, 2016, Murez and Recanati 2016; see Section 4.2).

[9] On the notion of "natural kind", see e.g. Quine (1969), Boyd (1991), Armstrong (1997), Lowe (1998), and Bird (2018). For another exposition of concept pluralism, see Weiskopf (2009).

An initial reply could be that such "sameness" is merely *illusory*. Casasanto and Lupyan (2015) advocate a strong variant of this view, where concepts vary in each use context, and our inability to tell them apart amounts to a form of *change blindness* (Simons and Levin 1998). Additionally, they maintain that we are led to this confusion by the use of the same word across different concepts: "(...) verbal labeling also contributes to the illusion that different representations activated by the same label are identical to one another." (Casasanto and Lupyan 2015: 560). However, at least three complications arise.

First, the "illusion" in question is precisely what needs to be accounted for by the theory of concepts. If the cognitive system treats prototypes, exemplars, theories etc. as pertaining to some common property irreducible to any of them, then something needs to *sustain* this "illusion".[10] This is exactly what the *concept* does: it "marks" information as pertaining to a particular entity/property. Hence, accounting for *seeming* conceptual identities effectively ends up reintroducing concepts to the theory.

Second, Casasanto and Lupyan's (2015) proposal relies on distinct concepts sharing a "verbal label". This, in turn, requires that the *same label* is recognized at different times. But if – as they maintain – "no idea is ever the same twice" (p. 543), then no labels should be either, since they are cognitive representations as well. Conversely, if labels can be stable across different uses, it is unclear why concepts themselves could not.[11]

Finally, a critical problem for pluralistic/eliminative views is accounting for *structurally complex concepts*. For example, BROWN DOG is a conjunctive concept that thereby licences deductive inference to DOG. Unless DOG was stable enough to maintain its identity when combined with BROWN, this generalization would be unexplained.[12] Given the centrality of complex compositional concepts to a range of semantic phenomena (including translation), conceptual identities need to be sufficiently stable across contexts to allow combination with other concepts without changing their identities in the process.

[10] By the same token, rejecting *metaphysical essentialism* as "illusory" would be insufficient for discarding *psychological essentialism* as an established cognitive phenomenon: see Mizrahi (2014).

[11] Words and concepts are also dissociated in ways that suggest words to be at most *indicative* but not *constitutive* of concept identities. For example, *homonymy* is readily possible without inducing judgements about e.g. *bank* having a unitary essence between river banks and financial institutions. An even clearer case is that distinct people can have the same name, which does not result in us thinking that they must be the same person. Even homonymous Frege-cases are possible, as observed by Kripke (1979).

[12] If DOG_1 appears alone and DOG_2 with BROWN (where $\text{DOG}_1 \neq \text{DOG}_2$), then deductive inference is not licensed between BROWN DOG_2 and DOG_1 without additional stipulations.

4.2 Concepts as pointers

Definitionalism, the prototype theory, and conceptual role semantics are all forms *descriptivism*: they assimilate concepts to descriptive information of some kind. Sections 4.1.2–4.1.4 argued that each of them faces serious problems. Despite this, Section 4.1.5 maintained that the notion of "concept" deserves to be retained. Consequently, some non-descriptive means are needed to identify concepts. This section covers the basic idea behind *conceptual atomism* (Section 4.2.1), and lays out the specific approach I adopt (Section 4.2.2).

4.2.1 Variants of conceptual atomism

Conceptual atomism is not trivial to characterize. The existence of complex concepts is undeniable, so maintaining that all concepts are atomic is unfeasible to begin with. Instead, as a first approximation, atomism states that concepts linked to *monomorphemic lexical words* (nouns, verbs, adjectives/adverbs) have no conceptual constituents.[13] The lack of conceptual constituents means that the concept cannot be divided into parts that would themselves be analyzable via additional concepts. This stands in contrast to all forms of descriptivism, where conceptual identities are fixed by further conceptual information. Definitions, prototypes, and conceptual roles are all themselves conceptually interpreted, and hence none of the corresponding theories is atomistic.

Conceptual atomism is commonly treated as equivalent with *informational atomism* (e.g. Laurence and Margolis 1999, 2003, Salo 2003, Jylkkä 2009, Kwong 2014). In informational accounts of semantics, the content of a concept is determined by an informational relation its activation bears to its referent or truth-conditions (Dretske 1981). For example, the concept DOG is systematically activated by dogs and nothing else; its activation by non-dogs being possible but not systematic. Therefore, its referential content is the set of dogs (or the property of "doghood", depending on further details of the analysis). The predominant pairing of conceptual atomism with informational semantics is largely due to these being combined in the work of Fodor (1990, 1994, 1998, 2008). However, they are logically distinct.[14]

[13] In DM, the SOs corresponding to traditional "lexical words" are not actually monomorphemic (see Chapter 3, Section 3.1.5), so the characterization should be modified to apply to *roots* or the root-categorizer complex. This will be discussed in more detail in Section 4.3.

[14] For instance, Prinz (2002) combines an empiricist account of concepts with informational semantics, which illustrates the dissociability of informational semantics from conceptual atomism. Leaving a comparison between

A useful distinction can be made between a computational *vehicle* and its *content* (Dennett 1991, Millikan 1993, Egan 2014, Piccinini 2015, Shea 2018). Vehicles are units internal to the computational system, individuated by their intrinsic formal properties (i.e. their "shape"). Contents are semantic interpretations assigned to vehicles.[15] Informational semantics concerns the determination of contents, i.e. the entities or properties in the world that concepts bear a reference relation to. In contrast, my present discussion concerns concepts as *vehicles*, i.e. computational units within the conceptual system (see Section 4.1.1). Atomism about vehicles is compatible with informational semantics, but does not require it. The remaining discussion in this section only concerns concepts understood as cognitive vehicles, irrespective of how their referential content (when such exists) is determined. Questions of reference-determination fall outside the scope of this dissertation.

A *prima facie* problem for conceptual atomism is the origin of the atomic concepts: if they are not built from a relatively small set of primitive concepts or assimilable to sensory-motor representations, it is not evident how they could be acquired. Fodor (1981) presented an influential argument that conceptual atoms must be *innate*, based on the assumption that learning a concept would be some kind of a hypothesis testing procedure. In order to formulate the hypothesis 'if something has the features F_1, ..., F_n, it falls under the concept C', one must already possess the concept C to begin with. Hence, hypothesis testing cannot provide C. The remaining possibility seems to be that it is innate. This leads to the view sometimes titled "mad dog nativism" (Cowie 1998, Rey 2014), according to which even concepts such as CARBURATOR or DOORKNOB would be innate.[16]

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his view and the one adopted in Section 4.2.2 for future work, I maintain that his account succumbs to similar problems as prototype theories in general (see Section 4.1.3).

[15]Some theories essentially identify contents with vehicles: e.g. Jackendoff (2002) states: "Semantic/conceptual structure does not *have* a semantics, it *is* the semantics for language" (p. 279, his emphasis). This *internalist* viewpoint assimilates semantics to the study of conceptual vehicles, discarding "contents" in any other sense (see also McGilvray 1998, 2002, Chomsky 2000b, Pietroski 2005b, Farkas 2006).

[16]Fodor revised his position in subsequent work, where he suggested that concept acquisition can involve prototype learning (Fodor 1998, 2008). According to his informational account of semantics, a concept is "locked" to its referential content via being reliably triggered by the activation of a prototype. The prototype itself can be learned empirically; what remains innate is the link between potentially learnable prototypes and concepts that they trigger. However, this would still not remove the innateness of concepts such as CARBURATOR as *vehicles*: even if the prototype of CARBURATOR is learnt, the link between the prototype and CARBURATOR is already "waiting" to be triggered prior to this learning. Hence, even Fodor's later position remains "mad dog nativist" with respect to concepts as vehicles.

A major problem with nativist atomism is that the acquisition of novel concepts is *productive*, which points to some generative procedure that can create novel concepts. Consider meeting a new person (e.g. Mary) and forming a concept of them, after which it becomes possible to think about a person *as* them (e.g. 'I wonder if that person is Mary', 'that is Mary over there', etc.). Apart from general considerations of the finitude of memory, there is no evidence of a strict upper boundary for the formation of such concepts. Furthermore, there is no credible account of how either phylogenic or ontogenic development could possibly have provided a readily available concept (MARY) waiting to be triggered by the person. The concept must somehow be *introduced* via the encounter.

A similar consideration can be extended beyond proper names. The evident non-innateness of concepts related to historical novelties (e.g. CARBURATOR, SMARTPHONE) and theoretically challenging notions that are only acquired late in life (e.g. UNIFORMITARIANISM, HERMENEUTICS) is not only due to nativism about them being strongly counter-intuitive (*pace* Fodor 2008: 146). It follows from the observable *productivity* of novel concepts being introduced as needed. While this productivity is different from the combinatorial productivity involved in linguistic syntax and compositional semantics, it is equally real and in need of explanation. Just as we do not run out of complex expressions, we also do not run out of atomic concepts: new ones can be coined indefinitely.

It might initially seem theoretically contradictory to allow novel atomic concepts to be generated. However, conceptual atomism does not require atomicity on the *implementational* level (see Chapter 2, Section 2.2.2). Assuming that concepts are implemented in the brain, there is no need to suppose them to correspond to single units on the anatomical level of analysis, such as neurons or molecules. Rather, conceptual atomism only entails that they are not constituted by other *concepts*.[17]

For a simple illustration, suppose that concepts are distinguished by numerical indices: C_1, C_2, etc. The concept-generating system could be analyzed as containing a *number generator* and some means to connect a number (or strictly speaking a *digit* representing a number) to a generic concept template ($\text{C}_{\_}$) . Activating the number generator would check the highest

[17]Hinzen (2006) argues that since atomic concepts are indefinable, they must have a *sui generis* existence that prevents their assimilation to physical structures (in e.g. the brain). In contrast, the present analysis provides an alternative that allows both atomicity and complex physical implementation: atomicity is a *computational*- or *algorihmic*-level property (depending on the granularity of the analysis), which simply means that the (complex) physical implementation does not implement other entities on the same level of analysis.

number generated so far (n), and apply a successor function to it. The generator would then attach the resulting new number ($n + 1$) to the generic concept template for formally identifying the new concept (C_{n+1}). The digits representing the numbers would themselves be computationally complex within the number generator, using e.g. binary or decimal encoding. However, since the digits are not *conceptually* complex, the scenario would exemplify conceptual atomism. This illustrates that even atomic concepts could be productively generated.[18]

4.2.2 Files, pointers, and memory locations

Fodor himself rarely specified atomism in computational terms. An exception to this is Fodor (2008: 92), where he suggests using the analogy of *files*: information can be stored "into" a concept, but its identity remains the same even across changes to the information stored. This notion has been developed in much more detail in the *mental files* framework (Recanati 2012, 2016, Murez and Recanati 2016), which concentrates on proper names. Recanati (2012) draws a distinction between (i) a mental file as a repository of information, (ii) the descriprive entries it contains, and (iii) its referential content.[19] Crucially, the mental file (as a cognitive vehicle) is only is individuated by its "file name": a formal identifier.

The file metaphor has also been utilized in cognitive psychology, where *object files* have been proposed as mental representations that track perceived objects to maintain their identity across changes (Kahneman et al. 1992, Gordon and Irwin 1996, Jordan et al. 2010, Green and Quilty-Dunn 2021). An important finding is that spatiotemporal properties are more important for the maintenance of object identity than descriptive properties such as color or shape (Mitroff and Alvarez 2007, Pylyshyn 2007). Object files are responsible for the judgement that the object remains the same across changes (as in '*that* object moved from there to here, and then changed its color'). Fodor and Pylyshyn (2014: 116) maintain that they act as pre-conceptual representations that are subsequently mapped to concepts.

Green and Quilty-Dunn (2021) suggest that object files should be treated as *pointers* to information stored in memory, using an analogy from *random-access memory* in modern computers. Information is stored in certain *memory locations*, and *addresses* are symbols that

[18]Of course, the present framework remains compatible with the innateness of some (perhaps many) concepts; I merely emphasize that "mad dog nativism" is not the *only* option for (vehicle-)atomism.

[19]Recanati further holds that the referent of a mental file is fixed via *acquaintance*: an intimate and non-inferential epistemic connection (see e.g. Evans 1982). Others have accepted the mental files framework but objected to the acquaintance requirement (Hansen and Rey 2016).

point to a location by allowing the processor to access its content. Accessing information in a memory location via its address is called *direct addressing*. Furthermore, since addresses are themselves computational vehicles, they can be contained in each other's locations. Accessing a location via an address stored in the location of another address is called *indirect addressing*. Overall, such *location-based addressing* has been considered central for implementing symbolic computation in cognitive systems (Gallistel and King 2009, Marcus et al. 2014).

Quilty-Dunn (2020) applies a pointer-based analysis to concepts, where a concept points to pluralistic information in a memory location. That is, atomic concepts are addresses for memory locations. In *Relevance Theory*, the notion of *conceptual address* has been used as a placeholder for what binds together different aspects of information related to a concept (Sperber and Wilson 1986, Carston 2002). However, this literature has not always been clear on whether the term "address" is used of the memory location itself or a dedicated symbol that serves as a pointer to it. If they were assimilated with memory locations, they would lack the kinds of computational capacities required of concepts. In particular, locations as such are not combined compositionally while concepts are (see Section 4.2.4). Following Quilty-Dunn, Relevance Theory's "conceptual addresses" can instead be treated as *pointers to memory-locations* in the conceptual system.

As pointers, concepts thus serve two related but distinct roles. First, they are formally individuated computational vehicles. Second, they provide links to memory locations in which information is stored. The non-constitutive status of prototypes, conceptual roles, etc. (see Section 4.1.4) now amounts to the formal identity of the concept (*qua* pointer) being distinct from the information stored in the memory location it addresses.

4.2.3 Logical Entry and Encyclopedic Entry

The memory location that a concept points to contains other concepts, as well as specifications of the relations they enter into. For example, the memory location of the concept DOG could contain ANIMAL specified as standing in an IF-THEN relation to it. Relevance Theory makes a further distinction between the *Logical Entry* and the *Encyclopedic Entry* as two subdivisions of conceptual memory (Sperber and Wilson 1986). Information in the Logical Entry is treated as *necessary* for the concept (such as dogs being animals). Information in the Encyclopedic Entry, in turn, only specifies contingent information (such as dogs being common pets). One way to specify this distinction is that anything contradictory with the Logical Entry is considered to be impossible, even under *pretence* scenarios (see Nichols and Stich 2000, 2003). In contrast, contents of the Encyclopedic Entry are not always falsified by possible counter-examples, and can be changed under pretence.

Importantly, the distinction between the Logical Entry and Encyclopedic Entry does not correspond to either the *analytic-synthetic* distinction in semantics, or the epistemic distinction between *a priori* and *a posteriori* knowledge. First, contents of either memory location are not constitutive of the concept's identity (see Section 4.2.2). Second, as illustrated by Kripke (1980), statements considered to be necessary are not always *a priori*. For example, WATER=H_2O is an example of an *a posteriori* statement often considered to be necessarily true (Putnam 1975). The Logical-Encyclopedic distinction can help understand this observation from a cognitive perspective: if some conceptual role (e.g. WATER=H_2O) is learnt but then stored in the Logical Entry of one of the concepts related (e.g. WATER), this facilitates it being judged to be an *a posteriori* necessity.[20]

The contents of Logical and Encyclopedic Entries are themselves conceptual: they contain pointers to other memory locations with their own Logical and Encyclopedic Entries. For example, ANIMAL contained in the Logical Entry of DOG points to its own Logical and Encyclopedic Entries (which might contain similar links to e.g. LIVING). In addition, the memory location can contain various links to non-conceptual information, such as perceptual, motor, or emotional activation patterns. Such associative relations function differently from conceptual inferences (Fodor 1998: 10), but for present purposes it suffices to allocate them to the Encyclopedic Entry as well.

4.2.4 Conceptual types and modes of combination

An important subset of the Logical Entry concerns the *conceptual type* that governs the concept's possibility to combine with others. For example, a *predicate* specifying a property (e.g. SMART) can be combined with a *constant* that specifies an individual (e.g. MARY) to yield a truth-evaluable predication (MARY IS SMART). The Fregean tradition treats these in terms of *adicity*, where concepts specify how many *arguments* they need and what type each argument

[20]Some such account of how *a posteriori* necessities are *cognitively possible* is needed, irrespective of how one orients to the prominent philosophical program of drawing modal conclusions based on thought-experiments (the so-called "method of cases"). For contrasting viewpoints on the latter, see e.g. Williamson (2007) and Cappelen (2012) on the one hand, and Baz (2016) and Machery (2017) on the other.

needs to have (Frege 1879, Montague 1970a,b, Heim and Kratzer 1998). I assume that human concepts operate in this manner, having adicities and specifications for which types of concepts can appear in which argument positions. While the SEMs of linguistic expressions are highly restricted in the conjunctivist analysis adopted in Section 4.3 (Pietroski 2005a, 2018), I make no conjectures about how conceptual types as such might be restricted.

Atomic zero-adicity concepts are *constants*. When an n-ary predicate is combined with arguments for all of its n argument positions, the resulting complex concept is a *proposition*, which is characterized by *truth-evaluability*: a proposition P is something of which it makes sense to say(/think): 'It is true/false that P'.[21] What unites propositions with atomic constants is their zero-adicity status: they cannot take arguments and are thus *saturated*.

The observation that both constants and propositions are saturated underlies the Fregean conception of semantic types. In standard formal semantics initiated by Montague (1970a,b, 1973), semantic types are based on the two basic classes of *entity* (e) and *truth-value* (t), and *functions* that are recursively specified based on the input and output type using *lambda calculus* (Church 1941).[22] Constants are of type $<e>$, propositions of the type $<t>$, and for any types a and b, the function $<a, b>$ is a type. Semantic composition is based on *function application*, where one expression denotes a function that takes another as an argument.

Monadic predicates have the type $<e, t>$, since applying them to an argument of type $<e>$ yields type $<t>$ (i.e. a proposition). *Dyadic predicates* are of the type $<e, <e, t>>$, since saturating them with one argument yields a monadic predicate, saturating which yields type $<t>$. *Predicate modifiers* have the type $<<e, t>, <e, t>>$: applying them to a monadic predicate yields another monadic predicate. Infinitely many more semantic types can be specified, but these three are the most relevant for upcoming parts of this dissertation.

[21] Like "concept", the term "proposition" has been used in a variety of ways (see e.g. Iacona 2002, King 2007, Soames 2010, 2015, Merricks 2015). Frege (1896/1952, 1918/1956) considered propositions to be shareable truth-value bearing abstract entities, while Russell (1903) analyzed them as complexes of concrete objects. In contrast, here I adopt the term in a different sense familiar from linguistics and cognitive science: propositions are truth-evaluable conceptual structures within the cognitive system (e.g. Giorgi 2010, Ramchand and Svenonius 2014, Wiltschko 2014, Ramchand 2018). For an original proposal to address the *unity problem* of propositions (Russell 1903) based on Minimalist syntax, see Collins (2011).

[22] Lambda-calculus allows expressing any function, such that $\lambda x : M$ stands for a function that returns M, where M is any (valid) expression. If the variable x appears in M, it takes the value of the argument given to the function. For a linguistic introduction, see Heim and Kratzer (1998). For a detailed proposal for an alternative conception of formal semantics without lambda-calculus, see Larson and Segal (1995).

Unsaturated predicates can also be *quantified* over, which *binds* argument positions and allows the formation of propositions without direct saturation by arguments. *Existential quantification* ($\exists$) over predicate P is interpreted as 'there is something of which P is true'; and *universal quantification* ($\forall$) over P is interpreted as 'P is true of everything'. *Second-order* predicate logic further allows quantifying over predicates, resulting in expressions such as $\exists P : P(\text{JOHN})$ ('John has some property').

Still other concepts take propositions as arguments. Truth-functional *Boolean* operators include the standard *logical connectives* of negation ($\neg$), conjunction ($\wedge$), disjunction ($\vee$), implication ($\rightarrow$), and equivalence ($\leftrightarrow$). Negation is *unary* in taking only one argument. The other logical connectives are *binary*, yielding a truth-value from two truth-values.

Other concepts are not applied for truth-values but rather the propositional content itself. For such cases, the standard approach in formal semantics has been to reanalyze propositions as functions from *possible worlds* to truth-values (Lewis 1986, Kratzer 2012). Unsurprisingly, this works well with *modal* concepts, such as POSSIBLE or NECESSARY. However, it is problematic with *propositional attitude* predicates such as BELIEVE, exemplified by (42a–b):

(42) a. Mary believes that $1 + 1 = 2$.

b. Mary believes that there are no round squares.

In (42a–b), both embedded clauses express *necessary* truths but the sentences clearly differ in conceptual content. This indicates that the *internal structure* of propositions needs to be available for at least some predicates that take propositional arguments (Soames 1988, Larson and Ludlow 1993). While this idea is problematic for the extensional and truth-functional framework of formal semantics, it can more readily be integrated within the present cognitive approach. Some predicates require a proposition (i.e. a saturated predicate) as an argument, and complex propositions are compositionally interpreted via their constituent structure.

As the discussion above illustrates, transporting Montagovian formal semantics directly into a cognitive theory of concepts is problematic. In general, formal semantic analysis is not intended to describe cognitive structures or operations, but the determination of referential or truth-conditional contents (Lewis 1970, Thomason 1974, Partee 1979). This stands in contrast with the *I-language* perspective (see Chapter 2, Section 2.2.1).[23]

[23] Lewis (1970) maintained that cognitive explanation is "at best a substitute for real semantics" (p. 18), where the latter concerns the determination of objective truth-values for (public) linguistic expressions.

Nevertheless, even for a theory specifically concerned with cognitive computation, Montagovian notation is useful for marking semantic adicity as a crucial aspect of a concept's type. In the present context, this notation should not be interpreted as dedication to the extensionalist and truth-functional framework of formal semantics. Instead, it is one way to express the idea that concepts can "fit" others in argument relations, and combining concepts results in complex concepts that inherit their properties from their constituents according to the mode of combination. This is a central property that needs to be incorporated into any tenable account of concepts, including the cognitive one advanced here.

4.2.5 Summary: concepts as combinable pointers

As depicted in Figure 4.1, the overall picture presented in Sections 4.2.2–4.2.4 treats concepts as multifaceted while still maintaining atomic formal identities. Conceptual memory stores information in separate locations, to which concepts provide "addresses" as *pointers*. The contents of a location specify properties of the concept that are considered either necessary (Logical Entry) or contingent but representative (Encyclopedic Entry). This account is atomistic about concepts as cognitive vehicles, while also maintaining the pluralism of information stored in conceptual memory (Quilty-Dunn 2020).[24]

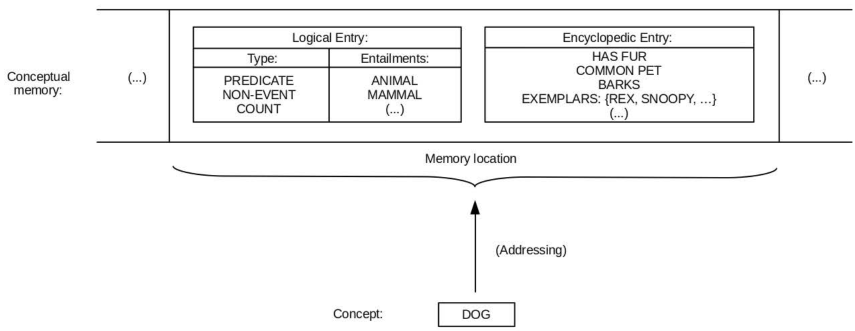


Figure 4.1: Concepts as pointers to locations in conceptual memory.

[24]See Harris (2022) for a recent related view. The present analysis of concepts also bears interesting similarities to certain variants of *substance-free phonology* on the phonological side (Blaho 2007, Iosad 2012, Odden 2013, 2021). Here, phonological features have no intrinsic phonetic content, but are introduced as needed based on the requirement of individuating classes for rule application. Phonological features could thus be analyzed as *pointers to phonetic information*, where phonological computation takes place on the level of pointers rather than the information they point to. Further investigation into the connections between the present approach to concepts and phonological theory is an intriguing prospect for future work.

The construction of complex concepts operates on the level of concepts as pointers, rather than directly on the information stored in their respective memory locations. Therefore, compositionality does not necessarily extend to e.g. prototypes (Fodor 1998; see Section 4.1.3). I assume that the conceptual system can use many kinds of semantic types, whereas the types linked to linguistic expressions is more restricted (as discussed in Section 4.3). In Montagovian terms, *constant* concepts are of type $<e>$, *propositions* of type $<t>$, *monadic predicates* of type $<e, t>$, *dyadic predicates* of type $<e, <e, t>>$, and *predicate modifiers* of type $<<e, t>, <e, t>>$. For convenience, I will use Montagovian notation as needed when discussing these. This should not be interpreted as commitment to the broader (extensionalist and non-cognitive) philosophical framework of mainstream formal semantics.

4.3 Linguistic meaning: the nature of SEMs

Section 4.3.1 discusses the SEMs of lexical items, and Section 4.3.2 the compositional SEMs of complex expressions. I begin from the basic idea of conjunction as the default SEM-correlate of Merge, and then move on to argument structure and higher syntactic domains. Combining this with the linguistic framework of Chapter 3, Section 4.3.3 formulates an analysis where each syntactic domain hosts a dedicated SEM-type.

4.3.1 Roots and categorizers

I assume that roots only receive a SEM when appearing together with a categorizer (Embick and Marantz 2008, Aquaviva 2014a,b,c, Panagiotidis 2015). The verbal categorizer (v) requires the SEM to *extend into time* (Panagiotidis 2015), while the nominal categorizer (n) does not determine an ontological class in the same way: while prototypical nouns denote concrete objects (e.g. *table*), event-denoting nouns also exist (e.g. *event* itself). However, the latter still "ignore" the *grammatical* marking of temporal extension (Aquaviva 2014a).

The status of adjectives and adverbs is more controversial, and many have denied their status as *sui generis* categories (Dixon 1982, Baker 2003, Mitrović and Panagiotidis 2020). As Borer (2013: 372) observes, the appearances of roots in nominal/verbal and adjectival environments are commonly disjoint.[25] On the other hand, adjectives have dedicated functional

[25]For example, *to dance* (verb) and *a dance* (noun) are both grammatical, but **too dance* (adjective) is not. Conversely, *green* can only appear as an adjective: **to green* (verb) or **a green* (noun) are disallowed.

categories: *degree* (Corver 1997, Neeleman et al. 2004) and *comparison class* (Bobaljik 2012). Furthermore, *adjectivizers* exist as category-switching heads similar to nominalizers or verbalizers, such as *-y* in *cloudy*. These considerations indicate that adjectives have some kind of a dedicated syntactic status (see also Panagiotidis 2015: 42–46).

As Lohndal (2020) notes, DM research has thus far not focused on the asymmetries between nouns/verbs and adjectives/adverbs. The remainder of this section focuses on verbal and nominal SEMs. I also abstract away from further details concerning categorization.[26]

Arad (2003, 2005) observes that languages differ with respect to how much independent meaning roots provide. As representative examples she treats English and Hebrew. English roots have fairly specific meanings independently of their syntactic context, and functional morphology generally does not determine their interpretation.[27] Many Hebrew roots, in contrast, take a variety of meanings depending on their morphosyntactic environment. The PHONs of Hebrew roots are consonant segments that make phonological words with additional functional material. Meanings taken by the root $\sqrt{qlt}$ are shown in (43):

(43) a. **q**a**l**a**t** ‘absorb/receive’ (verb)
b. hi**qlit** ‘record’ (verb)
c. mi**ql**a**t** ‘shelter’ (noun)
d. ma**ql**e**t** ‘receiver’ (noun)
e. ta**ql**i**t** ‘record’ (noun)
f. **q**a**l**e**t**et ‘cassette’ (noun)
g. **q**e**l**e**t** ‘input’ (noun)
(Arad 2003: 744; reprinted in Alexiadou and Lohndal 2017a: 91)

Alexiadou and Lohndal (2017a) suggest that languages fall within a typological continuum with respect to how specific root meanings are. English occupies one extreme, where root meanings are highly specified and rarely affected by functional structure. Hebrew occu-

[26]Roots have been treated as complements of categorizers (Harley 2014), adjuncts of categorizers (Marantz 2013), or some combination thereof (Embick 2004, Alexiadou et al. 2015); for a review, see Alexiadou and Lohndal (2017b). Borer (2005a,b, 2013) adopts an alternative view where no separate categorizers exist, and categorization is based on other functional heads (such as T or D).

[27]Alexiadou and Lohndal (2017a: 92) note that English root polysemy tends to be (semi-)idiomatic, as with $\sqrt{run}$ used in *take a run at it* or *run into someone*. They take this to be evidence for English roots being (mostly) fixed for meaning, lacking the kind of productive flexibility found in Hebrew.

pies the other extreme, where root meanings are highly underspecified and productively (i.e. not merely idiomatically) affected by functional morphology. Languages like Greek occupy a middle-ground, where unspecified roots exist but are less prominent than in Hebrew (Alexiadou and Anagnostopoulou 2008, Anagnostopoulou and Samioti 2014).

Another central question is whether root-SEMs are divisible into semantic classes. One such taxonomy is proposed by Harley (2005), who assigns English roots into three categories and derives verb classes via incorporation to "light verbs" (Hale and Keyser 1993, 2002). *Thing*-roots denote either *bounded* or *unbounded* entities (see e.g. Jackendoff 1991), and are incorporated into a light verb with the rough interpretation of 'produce'. The boundedness of a Thing-root determines the telicity of the resulting verb. *Event*-roots denote either (unbounded) activities or instantaneous (bounded) events; verbs formed via the latter also being called *semelfactives* (Comrie 1976, Smith 1991). These incorporate into a light verb with the rough interpretation of 'do'. *State*-roots combine with a light verb denoting 'cause' to yield a change-of-state verb that takes the argument undergoing the change as a direct object.[28] Examples of each type are shown in (44).

(44) a. $\sqrt{foal}$ (bounded Thing-root) — The mare **foaled** (telic verb)
b. $\sqrt{sweat}$ (unbounded Thing-root) — The athlete **sweated** (atelic verb)
c. $\sqrt{trip}$ (bounded Event-root) — Sue **tripped** (semelfactive verb)
d. $\sqrt{dance}$ (unbounded Event-root) — Sue **danced** (activity verb)
e. $\sqrt{clear}$ (State-root) — Sue **cleared** the table (change-of-state verb)
(Harley 2005: 47–53)

Harley thus gives *syntactic* explanatory status for *semantic* properties inherent to roots. The Thing/Event distinction and boundedness determine the telicity of an unergative verb derived via root incorporation, and change-of-state verbs require a State root.[29] This is contrasted by approaches that deny the syntactic relevance of root SEMs, and instead maintain that roots are interpreted based on the syntactic context (Borer 2005a,b, Åfarli 2007, Lohndal 2014, Aquaviva 2014a,b,c, Acedo-Matellán and Mateu 2014, Alexiadou et al. 2015, Acedo-Matellán

[28]This summary glosses over Harley's detailed discussion of the "small clause" analysis of change-of-state verbs (Hale and Keyser 1993) and whether boundedness figures in State roots (Hay et al. 1999).

[29]Harley's (2005) account is not the only proposal for an ontological taxonomy of root meanings (see e.g. Harley and Noyer 2000, Alexiadou et al. 2006, Rappaport Hovav and Levin 2010). For present purposes, it suffices as a representative example of the view that roots could be classified semantically.

2016). From the extensive literature, I consider two illustrative examples of this viewpoint: Aquaviva (2014b) and the later approach of Harley (2014).

Aquaviva (2014b) presents three empirical arguments against treating SEMs as inherent to roots. First, he notes the difficulty of capturing a semantic core for many roots. Even in English, roots like *-ceive*, *-mit*, or *-stand* lack common content across the words they occur in: e.g. *receive/perceive*, *admit/commit*, or *understand/withstand* (Aronoff 1976, 2007). Second, he stresses the distinction between a loose notion of "semantic relatedness" and the stricter notion of sharing a *common concept*. Root meanings are often semantically related in some way, but this does not yet justify postulating a single concept underlying them. For example, the French *fille* is polysemous between 'girl' and 'daughter'; but a single concept that captures both would be too general to rule out many other concepts not covered by *fille* (Fradin and Kerleroux 2009). Third, he argues that root meanings can vary based on syntactic context. For example, the English root $\sqrt{cook}$ has one interpretation in the standard verb *cook* (as in *cook dinner*) and another in the phrasal verb *cook up* (as in *cook up an evil scheme*) (Basilico 2008).

Following Borer (2005a,b), Aquaviva maintains that grammatically relevant aspects of "lexical" semantics (such as verbal aspect or the mass/count distinction in nouns) are syntactically determined by functional heads. Only phrases containing a root and such functional heads receive conceptual interpretations. The root merely serves a syntax-internal role of formal identification, which allows post-syntactic mapping of phrases to concepts based on which root they contain. In isolation, the root bears no intrinsic link to any concept.

Harley (2014) also adopts a formal account of roots lacking inherent content. Citing Aronoff (2007), she notes that some Hebrew roots satisfy grammatical criteria for morphosyntactic identity (ruling out accidental homophony) but appear in words with a wide array of meanings – ranging from e.g. 'pickle' to 'highway' for the root *kbʃ*. She further brings attention to roots which are only interpreted in specific syntactic contexts, such as *cahoot* in the expression *in cahoots with*. These observations lead her to adopt the account of Pfau (2009), where roots are only individuated by formal *indices* that mark their computational identities for NS and the two interfaces. The interfaces apply instructions for interpreting roots in different (more or less restrictive) morphosyntactic contexts. An example for the root $\sqrt{throw}$ is shown in (45), modified from Harley (2014: 244).[30]

[30]Harley's (2014) account differs from Aquaviva's (2014b) in assigning the SEM to the root and not a larger phrase containing the root. This difference ultimately concerns the possibility of *phrasal Spell-Out* (Starke 2009, 2014), of which I remain agnostic here. Harley further argues that roots can function as syntactic labels of larger

(45) $\sqrt{throw} \leftrightarrow$ 'vomit' / [v [_ up]]
$\leftrightarrow$ 'light pillow' / [n _]
(...)
$\leftrightarrow$ 'throw' / elsewhere

Initially, Harley's (2005) earlier ontological taxonomy of roots might seem incompatible with her later, indexical analysis of root identity. However, she accounts for their compatibility by assigning the ontological classes to the post-syntactically assigned meanings of roots, rather than roots (*qua* indices) themselves (Harley 2014: 243). Thus, such ontological distinctions can still be considered to characterize the *SEMs* of roots.

The analogy between Harley's analysis of root-SEMs and *Vocabulary Insertion* is clear (see Chapter 3, Section 3.1.8): the formal syntactic object is linked to an interface representation based on its intrinsic features (only the formal index for the root) and its syntactic context. This parallelism between the two interfaces underlies the present framework overall: akin to how syntactic heads are assigned PHONs via Vocabulary Insertion and complex phrases via linearization, syntactic heads are assigned atomic SEMs while complex phrases attain SEMs via simple modes of combination (the latter covered in Section 4.3.2).

Pietroski (2005a, 2008, 2011, 2018) provides a closely related but technically somewhat different analysis of lexical SEMs, outside of the DM framework. He begins with the standard Minimalist assumption that syntactic heads are composed of PHONs and SEMs in the Lexicon, and these are separated at Spell-Out (rather than inserted after it). In this lexicalist approach, distinct SEMs *ipso facto* require distinct heads. This is initially problematic in light of *polysemy*, where a head can receive diverse but related meanings (in contrast to mere accidental homophony). Consider the noun *book*, which has very different interpretations in (46a) and (46b) despite having a unified syntactic identity.

(46) a. Mary threw the book to the ground
b. Mary has the book on her computer

In (46a), *book* is interpreted as a concrete object, and in (46b) as abstract information content. If SEMs were direct links to concepts, they should thus be distinct. However, if SEMs were constitutive of roots, this would require two distinct homophonous roots for *book*

root phrases. I do not consider this possibility here. The approach to argument structure adopted in Section 4.3.2 does not treat any semantic arguments as complements of roots.

as well. If this is to be avoided (since *book* behaves like a single lexical item), one of the assumptions must be dropped: either SEMs are not constitutive of syntactic heads, or SEMs are not direct links to concepts. Pietroski proposes the second option, maintaining that SEMs are *instructions to fetch concepts from lexical addresses*, where lexical addresses are memory locations to which concepts are assigned when lexicalized. Crucially, more than one concept can *share* a lexical address.

If the two concepts $\textsc{book}_1$ and $\textsc{book}_2$ share a lexical address, it follows that the SEM of *book* can lead to fetching *either*, allowing polysemy. Which concept is fetched in any particular situation is affected by pragmatic considerations, and not determined by the SEM itself. Hence, SEMs are distinct from the concepts they can be used to fetch.

There are evident similarities between Pietroski's "lexical addresses" and Quilty-Dunn's (2020) account of concepts as *pointers*, as reviewed (and endorsed) in Section 4.2.2. Pietroski also treats the SEM of a word as a pointer to a memory location that contains pluralistic information. However, Quilty-Dunn diverges from Pietroski's view by maintaining that *concepts themselves* are inherently polysemous.[31] According to this view, concepts do not (at least usually) fix specific contents, but only a set of possible *constraints* for contents that are disambiguated in the context of the concept's deployment (see also Sperber and Wilson 1986, Carston 2002, 2019, Harris 2022). Both accounts suggest that lexical items are linked to atomic mental symbols that provide addresses for memory locations containing pluralistic information. For Pietroski, the memory location contains multiple concepts, one of which is fetched. For Quilty-Dunn, the addresses themselves are concepts.

A third option for polysemy – allowed by the Late Insertion of SEMs – is that a single root is assigned multiple SEMs. Here, the SEMs themselves would be concept-specific and unambiguous, as opposed to both Pietroski's lexical addresses and Quilty-Dunn's inherently polysemous concepts. Since roots are distinct from their PHONs, this view still allows maintaining the relevant distinction between homophony and polysemy: in homophony, two roots share a PHON; while in polysemy, one root has two SEMs.

Figure 4.2 shows the three possible accounts of polysemy covered here, adapted to the DM-analysis of lexical items (e.g. *book*) as root-categorizer complexes. Option (a) follows Pietroski in separating the conceptual address (@BOOK) from the concepts stored in the ad-

[31] As evidence for the conceptual rather than linguistic nature of the pointers, Quilty-Dunn (2020) cites experimental findings on words and visual images behaving similarly as ques for inference (Potter and Faulconer 1975) and sentence interpretation (Potter et al. 1986).

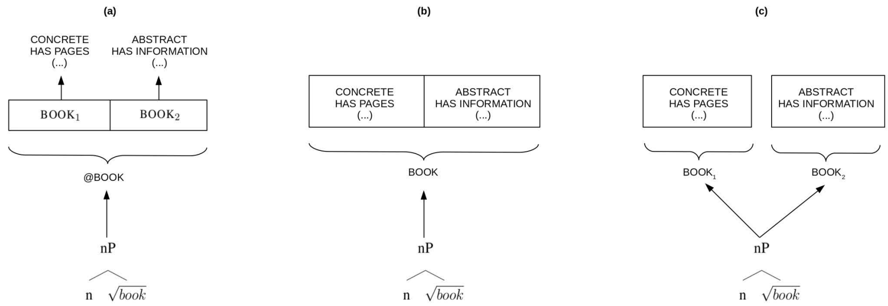


Figure 4.2: Three analyses of polysemy:

(a) multiple concepts in a single memory location (Pietroski 2018);

(b) polysemous information in the memory location of a single concept (Quilty-Dunn 2020)

(c) multiple concepts linked to a single lexical item (allowed by the Late Insertion of SEMs)

dress (BOOK_1 and BOOK_2). Option (b) is Quilty-Dunn's view that assimilates the concept with the address itself, and treats it as inherently polysemous by virtue of the memory location having pluralistic information, only some of which is deployed when the concept is used. Option (c) utilizes the Late Insertion of SEMs to allow a single (categorized) root to have multiple SEMs, each of which links to a dedicated concept.

If the Late Insertion of SEMs is assumed, differences between the three options in Figure 4.2 should not be exaggerated. First, if we map Pietroski's "SEMs" to Quilty-Dunn's "concepts", much of their disagreement fades. They both treat SEMs as pointers to memory locations, and polysemy as arising from the activation of different subsets of the pluralistic information stored in the location. Second, if roots are distinguished from their SEMs as in option (c), they become very close to Pietroski's "lexical addresses". Notably, Pietroski's distinction between SEMs and concepts hinges on the standard (lexicalist) Minimalist assumption that SEMs are constitutive of syntactic objects. If this is rejected in favor of the Late Insertion of SEMs, options (a) and (c) start to look very similar.

For present purposes, I allow both options (b) and (c) for polysemy. Assuming the Late Insertion of SEMs, Pietroski's distinction between SEMs and concepts is not required as a separate assumption, as the difference between polysemy and homophony is already accounted for by the distinction between the root and its SEM(s). Despite this deviation from Pietroski's model, from a higher-level perspective the present analysis is only a minor tweak on it. For notational convenience, in the remainder of this chapter I make the idealizing assumption that there is a single SEM for each (categorized) root, which is assimilated to a single concept (i.e. a single address/pointer for a memory location). If S is a SO, I denote its SEM as *SEM(S)*. This idealization glosses over the strictly correct reading of SEM(S) as one possible concept linked to S that is selected at the time of application.

4.3.2 Conjunctivism and the SEMs of complex phrases

Complex (non-idiomatic) expressions are *compositional* (Montague 1970b, Fodor and Lepore 2002, Hampton and Winter 2017). In the present framework, this means that the SEM of a complex expression is based on the SEMs of its constituents and their mode of combination. Accounting for complex SEMs thus requires specifying the semantic correlates of syntactic phrase structure. This section presents the *conjunctivist* analysis of complex SEMs, mostly based on the work of Pietroski (2005a, 2008, 2011, 2018).[32]

In the Fregean/Montagovian tradition, the main semantic mode of combination is *function application* (Montague 1970a, Heim and Kratzer 1998). As explained in Section 4.2.4, I assume this to be correct for concepts at large. Concepts are divided into types that determine how they can be saturated, and saturating all argument slots results in a truth-evaluable proposition. However, it does not follow that the syntactic Merge operation needs to be interpreted as function application. Conjunctivism presents an alternative, which aims to restrict possible SEMs to types that are actually empirically attested in natural language.

Pietroski aims for a simple and transparent mapping between syntactic phrases and their SEMs. To begin with, he proposes that Merge is mapped to conjunction at the syntax-semantics interface, as shown in (47).

(47) SEM(Merge(A, B)) = SEM(A) $\wedge$ SEM(B)

This principle applies in simple cases like the adjunction of subsective[33] adjectives, as shown in (48):

[32]For further developments or applications of conjunctivism aside of Pietroski's own work, see e.g. Hurford (2007), Hunter (2011), Boeckx (2014a), Lohndal (2014), and Gröndahl (2021).

[33]Non-subsective adjectives (such as *unlikely* or *possible*) are not covered by (47), and require further analysis techniques (see e.g. Kamp and Partee 1995, Pavlick and Callison-Burch 2016). I abstract away from them in this dissertation due to the complexity of the matter. Their incorporation into the conjunctivist framework would be an important objective for future research.

(48) [brown dog] $\Rightarrow$ $\text{BROWN}(x) \wedge \text{DOG}(x)$

brown — dog

$\text{BROWN}(x)$ — $\text{DOG}(x)$

The conjunction applies to *monadic predicates*, and is further restricted with respect to argument positions: these must be interpreted as applying to the *same variable*.[34] Therefore, the resulting conjunctive concept is also monadic. For example, *brown dog* can only have the SEM (49a) and not (49b):

(49) a. $\text{BROWN}(x) \wedge \text{DOG}(x)$

b. $^*\text{BROWN}(x) \wedge \text{DOG}(y)$

Using the abbreviation "<M>" for the Montagovian type $<e,t>$, Pietroski (2018) calls this variant of conjunction *M-junction*. It takes two SEMs of type <M>, and combines them into a conjunctive SEM that is also of type <M>. It is the basic SEM-correlate of Merge, which is applied when lexical items (i.e. categorized roots) are merged with low functional heads (such as verbal Aspect or nominal Number)[35] or (subsective) adjuncts.

However, M-junction evidently cannot handle *argument structure* and other inherently relational SEMs. For this, Pietroski relies on *neo-Davidsonian* event semantics (Higginbotham 1985, Parsons 1990, Schein 1993) and extends the theory with another mode of combination which he calls *D-junction*.

Consider the sentence *Mary swims*. Its Fregean analysis would be SWIM(MARY), where SWIM is a predicate taking MARY as an argument. Similarly, in the Fregean treatment of *Mary sees John*, the predicate SEE takes two arguments: SEE(MARY, JOHN). In contrast, the neo-Davidsonian analysis treats verbs as monadic predicates over existentially bound *event variables*, analogously to how nouns predicate objects(/masses). Thematic roles are dyadic relations between the event variable and additional arguments, as shown in (50)–(51).[36]

[34]As Pietroski (2018: 109–111) elaborates, there is an important difference between *argument positions* on the one hand, and *free variables* on the other. Strictly speaking, M-junction conjoins two SEMs of type <M>, and assimilates their argument positions. On the level of detail used in my current exposition, this is effectively equivalent with (49a), which uses a free variable; but they are actually not the same formulations from a logical perspective. For notational convenience, I abstract away from this distinction in the remainder of the dissertation. However, it needs to be taken into account when specifying conjunctivism with more technical rigor.

[35]To handle number and numerals, Pietroski (2018) modifies the system to use *plural variables*, originally introduced by Boolos (1984) and adopted for natural language semantics by Schein (1993).

[36]The term "neo" in "neo-Davidsonian" differentiates the analysis from Davidson's (1967a) original concep-

(50) *Mary swims*

Fregean: $\text{SWIM}(\text{MARY})$

Neo-Davidsonian: $\exists e : \text{SWIM}(e) \wedge \text{AGENT}(e, \text{MARY})$

(51) *Mary sees John*

Fregean: $\text{SEE}(\text{MARY}, \text{JOHN})$

Neo-Davidsonian: $\exists e : \text{SEE}(e) \wedge \text{AGENT}(e, \text{MARY}) \wedge \text{THEME}(e, \text{JOHN})$

One benefit of the neo-Davidsonian analysis of verbs is its simple treatment of (subsective) *adverbs*, which can be analyzed as additional predicates over the event, as in (52).

(52) *Mary swims quickly*

$\exists e : \text{SWIM}(e) \wedge \text{AGENT}(e, \text{MARY}) \wedge \text{QUICK}(e)$

The adjunction of *quickly* to the verb phrase can be accounted for by M-junction: both are monadic predicates over the same event variable, and adjunction corresponds to conjunction. This is depicted in (53), with SEMs below the respective phrases:

(53)

Mary swims	quickly
$\text{SWIM}(e) \wedge \text{AGENT}(e, \text{MARY})$	$\text{QUICK}(e)$

In contrast, incorporating *thematic arguments* such as Agent or Theme requires further means of analysis. Merging *Mary* to *swims* does not designate the conjunction of their SEMs, but rather a dyadic relation between MARY and the event variable. This is where D-junction becomes necessary.

Before presenting D-junction, I introduce a small but important modification to the current framework. Following Pietroski (2005a, 2018), I adopt a predicate analysis of proper names akin to Quine (1948, 1960) or Burge (1973). Instead of treating MARY as a logical constant, this view takes $\text{MARY}(x)$ to be a monadic predicate that applies to x if x is Mary.[37] Proper and common nouns are thus united in their SEM-type being $<$M$>$. With this modification, the analysis of e.g. *Mary swims* becomes (54):

tion, where event variables were added to the Fregean predicates instead of separating thematic roles from the verb. For arguments in favor of separating thematic arguments from the verb, see e.g. Parsons (1990), Schein (1993) and Lohndal (2014). In more elaborate analyses, clauses have been argued to have more than one event variable, which can be used to differentiate verb classes (Schein 1993, Kratzer 1996, Ramchand 2008, 2018). I abstract away from these details here.

[37] The fact that a constant concept MARY seems to be required for specifying what the predicate means is

(54) *Mary swims*

$\exists e : \text{SWIM}(e) \wedge [\exists x : \text{MARY}(x) \wedge \text{AGENT}(e, x)]$

The basis of D-junction is that the SEM of Merge(A, B) is a *dyadic relation* between the respective variables that SEM(A) and SEM(B) are predicated over. In (54), the verb predicates an event, the name predicates an entity (person in this case), and merging them relates these variables via the Agent role, as shown in (55):

(55)

Mary	swims	$\Rightarrow$	$\text{AGENT}(e, x)$
$\text{MARY}(x)$	$\text{SWIM}(e)$		

Even though both SEMs combined in (55) are monadic predicates, their respective variables are not assimilated as they would be in M-junction. Instead, the variables are distinct and linked by a separate dyadic relation. The question now arises of what determines when such D-junction is triggered and in what specific form: why does D-junction occur in (55) but not in e.g. (53); and why is the dyadic relation in (55) AGENT instead of e.g. THEME?

Hornstein and Pietroski (2009) propose that argument structure arises due to *label mismatches*. To take their example, the verb phrase *stab Caesar* contains a noun (*Caesar*), but is labeled by a verb (*stab*). This results in an asymmetry between the noun constituent and the label. Hornstein and Pietroski take this to trigger the interpretation of *Caesar* as the *internal argument*, which is Patient for the verb *stab*.[38] This is illustrated in (56):

(56)

stab (V)		$\Rightarrow$	$\text{INTERNAL}(e, x)$
stab (V)	Caesar (N)		
$\text{STAB}(e)$	$\text{CAESAR}(x)$		

However, label mismatch alone is insufficient to account for the difference between internal arguments and *external arguments* like Agent. For transitive verbs (like *stab*), it could be

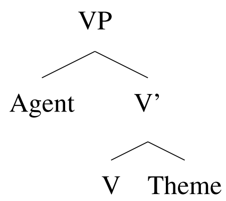
not a problem, since this can be seen as an *equivalence postulate* on par with those that link neo-Davidsonian monadic event predicates to Fregean polyadic predicates (Pietroski 2005a). Conceptual cognition may well contain constant concepts linked to <M>-SEMs via such equivalence postulates (see Section 4.2.4). See also Anderson (2007) for typological evidence that proper names behave like predicates in many languages.

[38] "Internal argument" is a generic term that can be interpreted more specifically for different verbs as e.g. a Theme or Patient. While I here follow Hornstein and Pietroski terminology when presenting their analysis, elsewhere in this dissertation I use "Theme" as a similar generic term.

possible to assign the external status to the higher noun argument: if e.g. *Brutus* is merged to the VP (56), it could be interpreted as external argument since the internal argument is already present. However, this does not for work intransitive verbs where the only argument is an Agent, such as *swim* in (55). Therefore, accounting for argument structure within conjunctivism requires more elaborate interaction between syntactic structure and SEMs.[39]

In G&B-theory (see Chapter 3, Section 3.1.1), thematic roles (also known as *theta roles* or *θ-roles*) were in a deterministic correspondence with the X'-schema according to Baker's (1988) *Uniformity of Theta Assignment Hypothesis (UTAH)*. This principle asserts that Comp,VP corresponds to Theme(/Patient)[40] and Spec,VP to Agent, as shown in (57).

(57)



Additionally, the lexical entry of each verb was assumed to contain a *θ-grid*, which specified the arguments needed (Chomsky 1981). Intransitive verbs like *run* only require an Agent, while transitive verbs like *kick* require both an Agent and a Theme. Relying on lexical θ-grids exemplifies what Borer (2003) calls *endoskeletal* explanation. It takes place "bottom-up" by accounting for syntactic behaviour via lexical features of syntactic heads, reflected as selectional restrictions for phrase-structure building. However, as Borer notes, the combination of UTAH with θ-grids is fundamentally redundant, as argument structure information is repeated both in the verb's lexical entry and its X'-theoretic phrase structure. Therefore, she proposes an *exoskeletal* account that discards lexical θ-grids. This view – also inspired by Hale and Keyser (2002) – takes thematic roles to be assigned by syntactic positions themselves.

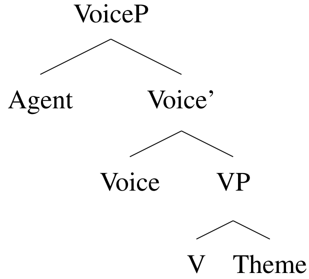
Kratzer (1996) argued that the Agent role is introduced in the specifier of a functional head *Voice*, which dominates the VP and determines the status of the clause as active or passive.

[39] In the Montagovian framework, intransitive and transitive verbs can be assigned different semantic types; $<e,t>$ for the former and $<e,<e,t>>$ for the latter (Heim and Kratzer 1998). However, this option is not available in conjunctivism, where every verb is of type $<e,t>$ – i.e. <M>. Furthermore, *transitivity alterations* speak against fixed semantic types of this sort (see e.g. Borer 2005a,b). For example, *swim* can take an optional direct object, such as *two laps* in *Mary swam two laps*. Neo-Davidsonian frameworks can better accommodate transitivity alterations, as the same event predicate can appear both with and without optional arguments.

[40] For convenience, I use the term "Theme" in a generic sense, comprising both Themes and Patients in more detailed analyses (see e.g. Jackendoff 1987, Van Valin 1999).

This analysis changes (57) into (58), where the VP only hosts the Theme complement and the Agent is allocated to the higher position Spec,VoiceP:

(58)



Many theorists have since argued (*contra* Kratzer 1996) that the Theme argument should also be separated from the verb (Borer 2005a,b, Åfarli 2007, Ramchand 2008, Bowers 2010, Acedo-Matellán 2016). Lohndal (2014) combines such an exoskeletal account of argument structure with a conjunctivist approach to the syntax-semantics interface. I present his analysis below, and adopt its basic premises in this dissertation.

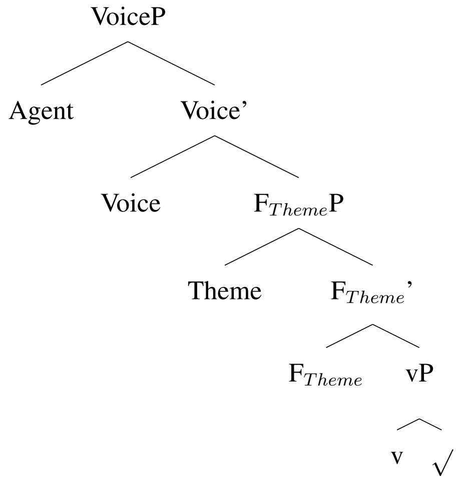
Lohndal (2014) maintains that both Agent and Theme are introduced by dedicated functional heads. He adopts Kratzer's (1996) Voice analysis of the Agent, but remains agnostic about the functional head hosting the Theme, simply calling it *F* and placing it between VP and Voice.[41] For notational transparency, I use the placeholder F_{Theme}. This analysis thus separates all thematic arguments from the verb, and allocates them to specifiers of dedicated functional heads.[42] Within the present framework, the remaining VP can further be assimilated with DM's vP: a combination of a root and a v-categorizer. This slightly modified decomposition of the extended verb phrase from Lohndal (2014: 94) is shown in (59).[43]

[41]The assumption that the Theme is syntactically lower than the Agent follows the original UTAH formulation where the Theme was in the complement of the VP and the Agent in the specifier. It is ubiquitous in the exoskeletal literature, but has been challenged by Bowers (2010), who argues for the converse order.

[42]Lohndal (2014) dispenses with the specifier-complement distinction (see Chapter 3, Section 3.1.2, Footnote 6), and hence formulates the principle as applying between a head and its *complement* (p. 108). I abstract away from this aspect of his analysis, and retain the standard X'-theoretic terminology that the arguments are specifiers. While my approach is compatible with Lohndal's view on specifiers, adopting it is not necessary for present purposes.

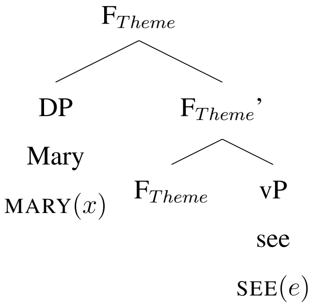
[43]*Ditransitive* verbs (such as *give*) take an additional *indirect object*, which typically corresponds to a *Recipient* or *Benefactive* role. On the syntax of ditransitive constructions, see e.g. Larson (1988), Pesetsky (1995), Harley (2002), and Cuervo (2010). From an exoskeletal perspective, indirect objects can be treated as *applicatives* introduced in the specifiers of Appl heads, which may come in different kinds (Pylkkänen 2008). They may also involve complex event structure with multiple event variables (Schein 1993, Ramchand 2008). I do not

(59)



Lohndal (2014: 108) proposes a principle called *Thematic Integration*, which maps certain functional heads and their specifiers to thematic relations. It relates the verb's event variable to the variable predicated by the SEM of the argument of a functional head H. The nature of this relation (e.g. AGENT or THEME) is based on the syntactic status of H (e.g. Voice or F_{Theme}). In addition, *existential closure* is applied to the variable introduced in the argument position, and all SEMs in the structure are conjoined. The assignment of the Theme *Mary* for the verb *see* is shown in (60), with SEMs below the syntactic objects:

(60)

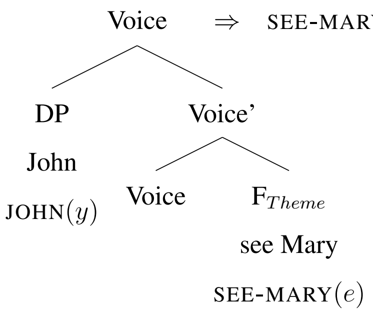


$\Rightarrow$ SEE$(e) \wedge [\exists x :$ MARY$(x) \wedge$ THEME$(e, x)]$

Due to the existential closure over the thematic argument variable, the resulting SEM of F_{Theme}P in (60) is of type <M>: the event variable e is the only free variable in the complex formula. Therefore, Thematic Integration can be re-applied, this time with the Voice head introducing the Agent. Using "SEE-MARY(e)" as an abbreviation of the SEM in (60), the addition of the Agent *John* is shown in (61):

discuss ditransitivity further in this dissertation, although it deserves more focus in future work.

(61)



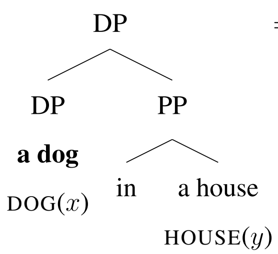
$\Rightarrow$ $\text{SEE-MARY}(e) \wedge [\exists y : \text{JOHN}(y) \wedge \text{AGENT}(e, y)]$

Hence, the full SEM of the VoiceP (61) is (62), which is of the type <M>: a monadic predicate over the event variable e.

(62) $\text{SEE}(e) \wedge [\exists x : \text{MARY}(x) \wedge \text{THEME}(e, x)] \wedge [\exists y : \text{JOHN}(y) \wedge \text{AGENT}(e, y)]$

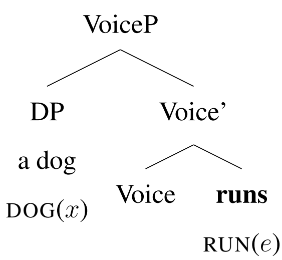
While Lohndal's analysis differs in certain technical respects from Pietroski's (2018) specific formulation of D-junction, for present purposes Thematic Integration can be treated as a variant of D-junction. Other variants involve *adpositions* (P). At least initially, it seems that the SEMs of adpositions are dyadic relations between the two phrases they connect. However, existential closure functions differently between these and argument-introducing heads in the verb phrase. In the latter, the existentially bound variable corresponds to the specifier of the functional head introducing the relation (Voice or F_{Theme}). I contrast, the SEMs of PPs like *in a house* are predicates applied to the phrase the PP modifies. This difference is illustrated in (63a–b), where the SEM with the free variable is bolded:

(63) a.



$\Rightarrow$ $\text{DOG}(x) \wedge [\exists y : \text{HOUSE}(y) \wedge \text{IN}(x, y)]$

b.



$\Rightarrow$ $\text{RUN}(e) \wedge [\exists x : \text{DOG}(x) \wedge \text{AGENT}(e, x)]$

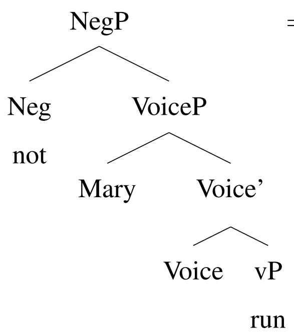
Hence, while both argument-hosting functional heads and adpositions induce D-junction, they do so in importantly different ways with respect to existential closure. Nevertheless, both still result in complex SEMs of type <M>, which allows them to function recursively as arguments of additional applications of M- or D-junction. Section 4.3.3 returns to the analysis of adpositions in some more detail.

The basic conjunctivism presented so far works well for what Ramchand (2008) calls the *first phase* in the derivation of the clause, which involves the verb, its thematic arguments, and possible (subsective) adjuncts. Here, the complex SEMs involved are strictly conjunctive: an element appearing in the structure means that its SEM is conjoined into the SEM of the structure. However, all linguistic semantics cannot be analyzed as conjunctive.

To begin with, *negation* is evidently non-conjunctive and thus requires further means of analysis. Its standard interpretation in formal semantics is to treat it as a truth-functional operator, changing True to False and vice versa (see Section 4.2.4). As truth-values are not directly present in conjunctivist SEMs, this standard account of negation is not available.

Following Tarski (1944), Pietroski (2018) introduces an *arrow operator* $\Downarrow$ that applies to a monadic predicate P, where $\Downarrow P(x)$ yields another monadic predicate interpreted as 'y is such that $\neg\exists x : P(x)$'. Since the free variable y is not part of the existentially bound embedded formula, $\Downarrow P(x)$ will apply to *either everything or nothing*, depending on whether or not P applies to nothing. An example is shown in (64):

(64)



$\Rightarrow\ \Downarrow(\textsc{run}(e) \land [\exists x : \textsc{mary}(x) \land \textsc{agent}(e, x)])$

The predicate that the arrow operator takes as its argument applies to nothing if $\neg\exists e : \textsc{run}(e) \land [\exists x : \textsc{mary}(x) \land \textsc{agent}(e, x)]$; i.e. if no event is a running by Mary. Hence, (64) applies to everything if Mary does not run, and otherwise applies to nothing. Pietroski also introduces a converse "positive" arrow operator $\Uparrow$, where $\Uparrow P(x)$ is interpreted as 'y is such that $\exists x : P(x)$'. Similarly, this predicate applies to everything or nothing depending on whether P applies to something. Pietroski calls SEMs of the form $\Downarrow P(x)$ or $\Uparrow P(x)$ *T-concepts* (after

"Tarski"). He also allocates the functional heads introducing them to the syntactic T-domain of the clause, which hosts e.g. tense, negation, and modality.

The arrow operators make a monadic predicate out of another monadic predicate P by first existentially quantifying the free variable of P and then introducing another free variable in the novel predicate. This makes their semantic type <M, M>: they are *predicate modifiers*. T-concepts thus illustrate the need to append conjunctivism with predicate modifiers for increasing its expressive power to cover non-conjunctive SEMs such as negation.

The C-domain of the clause then further modifies the T-concepts for possible uses in *speech acts*, such as making statements, asking questions, or issuing commands. This reflects the division of semantics into two basic kinds: one based on assembling complex structures, and the other using these structures for "secondary" purposes (Chomsky 2005). It is also reminiscent of Frege's (1879) original distinction between *content* and *force*.

So far, the most explicit formulation of C-domain SEMs from a conjunctivist perspective has been Lohndal and Pietroski's (2011) analysis of questions. Without going into much detail here, their basic idea is that C-domain SEMs are operators that take T-concepts as arguments and yield instructions to form declarations/queries/commands of whether the T-concept applies to everything or nothing. For example, QUERY:$\Downarrow P$ is an instruction to form a query of whether $\Downarrow P$ applies to everything – i.e. whether $\neg\exists x P(x)$ is true. Lohndal and Pietroski also propose an abstraction operation akin to lambda-abstraction (Church 1941) to account for *wh*-phrases, and connect their analysis to Cable's (2010) syntactic account of *wh*-movement.[44]

Further elaboration would be needed to expand the conjunctivist framework for quantification (Pietroski 2003, 2005a, 2018), intensional contexts (Pietroski 2000), modality (Lewis 1986, Kratzer 2012), non-subsective modifiers (Kamp and Partee 1995, Pavlick and Callison-Burch 2016), and many other non-conjunctive aspects of SEMs. I abstract away from these manifold and complex matters here, but their analysis will be crucial for developing conjunctivism into an encompassing semantic framework.

4.3.3 SEMs and syntactic domains

I propose that conjunctivist framework should be connected to *syntactic domains* as discussed in Chapter 3. Lohndal and Pietroski (2011) note a link between the conjunctivist syntax-semantics interface and the syntactic structure of the clause:

[44]For another approach to the effects of movement on SEMs in conjunctivism, see Hunter (2011).

> “(..) one can view a matrix sentence as a tripartite instruction: a ‘lower’ portion that directs construction of a concept of events/states of some kind; a ‘middle’ portion that directs construction of a T-concept; and an ‘upper’ portion that directs a more specific tailoring of the assembled concept to the demands of specific interfacing systems”
> (Lohndal and Pietroski 2011: 476, Footnote 19)

The three “portions” can be assimilated to the *prolific domains* of Grohmann (2003, 2011), covered in Chapter 3 (Section 3.1.7). The lower portion corresponds to Domain 1, headed by VoiceP. The middle portion corresponds to Domain 2 that contains functional heads such as Tense and Negation. The upper portion is Domain 3 – i.e the “left periphery” (Rizzi 1997). These map to the traditional V-T-C structure of the clause (Chomsky 1986a), where Domain 1 is the split VP, Domain 2 the split TP, and Domain 3 the split CP.

Domain-based semantics has mostly been discussed outside conjunctivism. Ramchand and Svenonius (2014) propose that the lowest domain describes an *event*, the second a *situation*, and the third a *proposition*. Each type subsumes the lower one. Events are characterized by thematic roles, stativity/dynamicity, and causal relations among subevents (Ramchand 2008, 2018). Situations are anchored in time (Giorgi and Pianesi 1997) and possible worlds (Lewis 1986), and can have *topics* (Austin 1950). Propositions are anchored to the context of the utterance, having illocutionary force as well as speaker-oriented parameters (Giorgi 2010).

Wiltschko (2014) divides extended projections into four domains which she calls *classification*, *point-of-view*, *anchoring*, and *discourse linking*, in the order from syntactically lowest to highest. In clauses, the classification layer classifies the event type and hosts the lexical verb; the point-of-view layer relates it to an utterance-independent reference (e.g. reference time in Aspect); the anchoring layer relates it to the utterance (e.g. utterance-time in Tense); and the discourse linking layer connects it to the broader discourse (Wiltschko 2014: 74–75).

Unlike the verb/clause-specific semantic categories of Ramchand and Svenonius (2014), Wiltschko’s domains are also manifested outside the clause, with e.g. the anchoring domain corresponding to the D-layer in noun phrases (Wiltschko 2014: 207–230). This extension is an important benefit of the analysis, given the much-documented parallels between clauses and noun phrases (Jackendoff 1977, Fukui 1986, Lamontagne and Travis 1986, Abney 1987, Ogawa 2001, Koopman 2005). Another major contribution of Wiltschko’s work is the application of the domain-based analysis (which she calls the “Universal Spine Hypothesis”) across a typologically broad range of languages, which can display significant variation in the semantic interpretation of grammatical markers while still conforming to the domains (Wiltschko 2013, 2014, Ritter and Wiltschko 2014).[45]

I follow Wiltschko (2014) in assigning syntactic domains with generic, non-verb-specific SEMs, but follow Ramchand and Svenonius (2014) in retaining the standard three-fold distinction between domains. Wiltschko's point-of-view and anchoring domains can be assigned to the lower and higher part of Domain 2, respectively. I also deviate both from Ramchand and Svenonius (2014) and from Wiltschko (2014) in further details. Specifically, I propose that the SEM-correlates of syntactic domains are based on the *modes of SEM-combination* they allow.

In Domain 1, complex SEMs are created via either M-junction (for functional heads and adjuncts) or D-junction (for thematic roles). Both M-junction and D-junction are conjunctive: the SEMs of all constituents of the complex expression are conjoined to the complex SEM. Hence, Domain 1 SEMs are restricted to the conjunctive combination of constituent SEMs, such that each complex SEM is of type <M>.

In contrast, complex SEMs in Domain 2 are not (at least necessarily) conjunctive. For instance, the arrow operators ($\Uparrow$, $\Downarrow$) are predicate modifiers of type <M, M>. This type is very allowing in the kinds of complex SEMs it can produce, as there is no longer a need for the complex SEM to entail its constituent SEMs. It thus has potential for accommodating many other parts of Domain 2 as well, such as modality or evidentiality.[46] I therefore propose that complex Domain 2 SEMs are restricted to the type <M> (like in Domain 1), but can be produced via predicate modifiers rather than conjunction.

Together, Domains 1–2 yield complex SEMs of type <M>. Domain 3 SEMs are less clear, as they come in many variants that share no clear semantic type. For instance, the clausal C-domain can contain functional heads for marking Force, positions for hosting *wh*-movement, or clausal connectives. Initially, it seems difficult to unite these in terms of SEMs. However, I propose that they all provide ways to *link the Domain 2 SEM to something else*, beyond the extended projection.

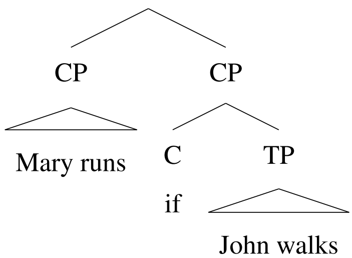
[45] For example, Wiltschko (2014) proposes that Blackfoot, Halkomelem, and Upper Austian German all lack Tense as an anchoring category, but instead anchor the event to person (Blackfoot), location (Halkomelem), or the realis/irrealis distinction (Upper Austrian German).

[46] For instance, a modal predicate modifier POSSIBLE could be defined such that POSSIBLE:$P(x)$ is interpreted as 'x is such that it is possible that $P(x)$'. Consequently, e.g. POSSIBLE:$\Uparrow P(x)$ would apply to everything or nothing based on whether it is possible that P applies to something.

Each of the three analyses discussed above treats Domain 3 SEMs as linking the Domain 2 SEM to something outside the linguistic system proper. For Lohndal and Pietroski (2011), Force operators (such as QUERY) are instructions for cognitive systems interfacing with language to construct further representations eventually used in the generation of speech-acts. For Ramchand and Svenonius (2014), Domain 3 incorporates the situation (specified in Domain 2) into a proposition. As the name suggests, Wiltschko's (2014) discourse linking layer connects the SEM to the broader discourse. These can all be subsumed under the generic scheme of *linking the Domain 2 SEM to extra-linguistic cognition*.

In contrast, some Domain 3 SEMs are clearly linguistic, and thus cannot be analyzed as linking the Domain 2 SEM to something extra-linguistic. For example, *connectives* allow embedding a clause inside another, and are typically allocated to the C-domain. For example, the connective *if* can occupy the C-head (or, more precicely, some head in the C-domain), which allows the clause to modify another clause, as in (65):

(65)



However, even here the connective can be analyzed as linking the Domain 2 SEM to something *outside the extended projection*, even if this target representation remains within I-language. The main clause in (65) is *Mary runs* rather than *John walks*. The embedded clause *if John walks* functions only as a modifier for the main clause. Therefore, the respective verbs can be seen as initially belonging to different extended projections, subsequently linked by the connective. In effect, the connective functions as a "switch" between them, allowing the extended projection of *walks* to be incorporated into the the extended projection of *runs*.

The SEMs of C-domain heads could thus be treated as generic "linking devices" that connect the Domain 2 SEM to something else. Force markers link it to e.g. a proposition, a discourse representation, or some other aspect of extra-linguistic cognition. Connectives link it to another extended projection in NS. This is schematically shown in (66a–b):

(66) a. Force TP $\Rightarrow$ Link SEM(TP) to proposition/discourse/...

b. connective TP $\Rightarrow$ Link SEM(TP) to another extended projection

It is now possible to formulate a general hypothesis on the modes of SEM-combination used at each syntactic domain. Domain 1 involves SEMs of type <M> combined via M-junction or D-junction, where the complex SEMs are conjunctive. Domain 2 also involves complex SEMs of type <M>, but attained via predicate modifiers. Domain 3 then links the SEM formed at Domain 2 to some representation outside the extended projection. This is summarized in Figure 4.3, which maps the generic structure of an extended projection (Chapter 3, Section 3.1.7) to the modes of SEM-combination used in each domain.

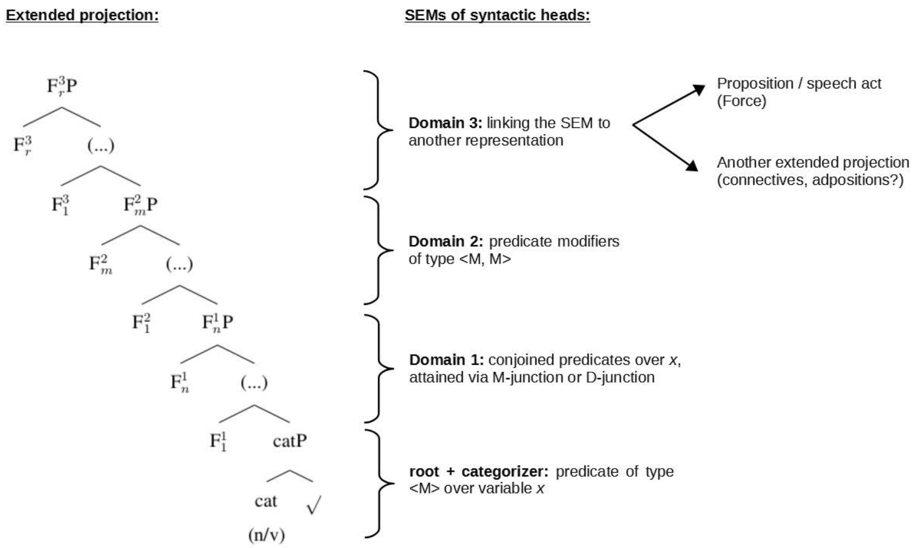


Figure 4.3: SEM-correlates of syntactic domains.

The analysis is plausible for nominal domains as well. The SEM of an nP is a concept of type <M>, and M-junction can be applied to Domain 1 functional heads (e.g. Number; see Footnote 35) as well as (subsective) adjuncts. Possible arguments of nouns, such as the *Possessor*, can be added via D-junction in the same way as thematic arguments of verbs. The nominal Domain 2 corresponds to the DP (Abney 1987, Grimshaw 1991, Ogawa 2001, Wiltschko 2014), and commonly encodes definiteness or specificity.[47]

[47]On the semantics of definiteness, see e.g. Christophersen (1939), Hawkins (1978), Kamp (1981), Heim

The noun phrase has also been suggested to contain a correlate of the clausal CP. This has been proposed to host landing sites for movement (Szabolcsi 1983, Ogawa 2001), case (Lamontagne and Travis 1987, Loebel 1994, Bittner and Hale 1996, Ogawa 2001), and adpositions (Grimshaw 1991, 2005), among others. *Quantifiers* have also been allocated to a functional projection above DP (Schlonsky 1991, Rutkowski 2002, Gianollo et al. 2021), but this alone does not reveal whether they reside in Domain 2 or 3.

For an illustrative example of how Domain 3 SEMs could work in the noun phrase, Grimshaw (1991, 2005) proposes that adpositions are analogous to C, and hence PPs are the nominal variant of the CP. Within the present framework, this would imply that the semantics of adpositions should be analyzed as linking the SEM of their complement-DP to something outside the nominal extended projection. This seems correct: the syntactic label of a PP with two semantic DP-arguments is not P but D, assigned by the higher DP. Example (63a) from Section 4.3.2 showed this, repeated below as (67):

(67) a dog ($\textsc{dog}(x)$) [in a house ($\textsc{house}(y)$)] $\Rightarrow$ $\textsc{dog}(x) \wedge [\exists y : \textsc{house}(y) \wedge \textsc{in}(x, y)]$

Importantly, the extended projection of (67) is headed by *dog*, not *house*. Hence, the preposition could be treated as a linking device that changes the extended projection, akin to clausal connectives. This parallelism is illustrated in (68):

(68) a. connective TP $\Rightarrow$ Link SEM(TP) to another extended projection

b. P DP $\Rightarrow$ Link SEM(DP) to another extended projection

That is, just as e.g. the CP *if John walks* provides a way to link its complement TP (*John walks*) to another extended projection, a PP such as *in a house* similarly allows linking its complement DP (*a house*) to another extended projection. Adpositions could thus be the nominal counterpart of clausal connectives. This receives further support from functional heads that can function as both prepositions and connectives, such as *before*, *after*, or *until*. It also fits well with the allocation of case to a separate *KP*-projection (Lamontagne and Travis 1987,

(1982), Lyons (1999), and von Heusinger (2013). While I am optimistic that a predicate modifier analysis could account for the SEMs of functional heads in the DP, I leave its further investigation for future work.

Loebel 1994), which can be considered to parallel C as well (see Chapter 3, Section 3.2.3). Adpositional meanings can be expressed via case in many languages, including Finnish (Nikanne 1993). Uniting K and P as morphological variants of the same underlying type of functional head would therefore be a viable prospect.[48]

Many issues must be left undiscussed due to their complexity and/or lack of direct relevance for the dissertation at large. In particular, I have not discussed Pietroski's account of quantification, which relies on the introduction of another SEM-type (<t, e>) (Pietroski 2003, 2005a, 2018). Another limitation has been the omission of adjectives and adverbs, beyond using them as examples of simple predicates in M-junction. This is insufficient to account for *non-subsective* adjectives/adverbs, the analysis of which I allocate to future research due to the many complexities involved (Kamp and Partee 1995). Further challenges arise from intensional contexts, such as attitude ascriptions. While these have been schematically discussed in Pietroski (2000), their thorough incorporation to conjunctivism would require significant additional work.

4.4 Summary

This chapter has covered the theoretical status of concepts (Section 4.1), their analysis as compositionally combinable pointers to pluralistic information (Section 4.2), and the conjunctivist framework for the syntax-semantics interface (Section 4.3). Together, these concern how concepts relate to syntactic objects in terms of their semantic types, and how the SEMs of complex syntactic phrases are constructed from the SEMs of their constituents. The account combines two important desiderata for analyzing semantic phenomena (including translation)

[48]PPs have also been argued to project dedicated argument structure akin to transitive verbs, with a *Ground* argument occupying the lower position and a *Figure* argument occupying the higher one (Hale and Keyser 2002, Svenonius 2008). This would be compatible with my approach as well. If P introduces a dedicated variable that takes arguments, the SEM of its complement DP is still linked to another phrase, which serves as the Figure argument and labels the resulting phrase. Hence, P would still link SEM(DP) to something outside its extended projection. On the other hand, Svenonius (2008) further argues that adpositions have dedicated roots and a categorizer (p), which makes them lexical instead of functional projections. In the present framework, this would not be compatible with the analysis of P as the correlate of C, which follows Grimshaw (1991, 2005). Since the status of prepositions is not the focus of this dissertation, I refrain from discussing this matter further. Even if the analysis of P as the nominal correlate of C turned out to be mistaken, the present exposition demonstrates the expressive strength of the domain-bound conjunctivist framework beyond only clausal SEMs.

from a cognitive perspective: it is sensitive to compositionality (unlike e.g. prototype theories or conceptual role semantics) while also limiting the range of possible SEMs to those actually required for natural language semantics.

In addition, I presented a novel mapping between syntactic domains and SEMs, where Domain 1 hosts conjunctive SEMs of type <M>, Domain 2 hosts complex SEMs of type <M> attained via predicate modifiers (<M, M>), and Domain 3 links the Domain 2 SEM to another representation outside the extended projection. This framework provides the theoretical basis for the analysis of translation provided in forthcoming chapters.

Chapter 5

Translation

Using the theoretical framework presented in Chapters 3–4, this chapter constructs a novel analysis of translation as an aspect of cognitive competence. I argue that the capacity follows automatically from bilingual competence, in line with Harris' (1976) *natural translation* hypothesis (see Chapter 2, Section 2.1). In contrast to a predominant assumption in prior literature, I maintain that translation should not be treated in terms of *overlap* between conceptual contents across expressions, but instead as an *inferential* relation between concepts linked to different languages. I propose that the inferential relation involved in translation is a restricted variant of *entailment*. This analysis is applied to both lexical and phrasal translation, assuming that the syntax-semantics interface operates in the manner presented in Chapter 4.

Section 5.1 discusses three variants of the conceptual overlap account of translation: *universalism*, *relativism*, and *partial overlap* accounts. All are deemed unsuitable, which results in the need to reconsider the fundamental basis of translation. Section 5.2 presents an alternative to conceptual overlap, where translation is instead treated as a variant of inference. Criteria for the adequate type of inference are discussed, which leads to the proposal of *immediate entailment* as the conceptual basis of translation. This analysis is subsequently applied to *compositional translation*, where a complex expression's translation depends on the translations of its constituents. Finally, Section 5.3 covers prior empirical findings on *translation universals*, which are properties uniquely manifested in translated text. I demonstrate how these results can be explained in a novel way within the present framework.

5.1 The inadequacy of conceptual overlap

A ubiquitous assumption in prior literature has been that translation is based on reproducing the *same* semantic/conceptual contents across languages (see Chapter 2, Section 2.3). This has been considered even close to definitional, as the quote from Jackendoff below illustrates:

> "(...) translations of words and sentences into a different language should preserve meaning – *that's what translation is*"
> (Jackendoff 2012: 47, my emphasis).

However, while Jackendoff's contention is indeed appropriate as a common-sense attitude toward "what translation is", this is not a sufficient reason to take it *literally* at further stages of analysis. Something we intuitively judge to "preserve meaning" can still be based on cognitive processes that do not literally involve the preservation of conceptual structure.

For comparison, it might seem self-evident that language involves words; but it does not follow that "words" need to retain a theoretically central position in linguistics. As covered in Chapter 3, they have no dedicated syntactic status in the DM framework. This does not mean that the common sense description of language involving words is incorrect; it simply means that this pre-theoretical consideration does not map 1–1 to syntactic units in DM. I suggest that we should maintain a similar attitude to the contention that translation involves "preserving meaning" across languages. This pre-theoretical notion can be retained in everyday discourse, without requiring that it has a dedicated place in the cognitive theory itself.

This section covers three variants of the conceptual overlap approach to translation, and deems all to be inadequate. Section 5.1.1 discusses *universalism*, Section 5.1.2 *relativism*, and Section 5.1.3 the idea that translation is based on maximizing conceptual overlap, which may only be *partial*. Universalism and relativism stand in evident contradiction to empirical observations: languages can vary in the range of concepts they can express; but this does not yield languages semantically incommensurable – as the possibility of translation itself already demonstrates. Moreover, while the partial overlap account initially seems like a reasonable middle-ground position between universalism and relativism, it succumbs to two major problems. First, it is difficult to reconcile with conceptual atomism, which was motivated on an independent basis in Chapter 4. Second, it fails to account for *compositional translation*, in a manner that echoes Fodor's (1998) argument against the prototype theory.

5.1.1 Linguistic universalism

An initially attractive possibility for why translation can occur would be that concepts are *shared* between the source and target language. Such strong universalism seems to have been advocated by Jakobson:

> "All cognitive experience and its classification is conveyable in any existing language. Whenever there is deficiency, terminology may be qualified and amplified by loanwords or loan-translations, neologisms or semantic shifts, and finally, by circumlocutions. (...) No lack of grammatical device in the language translated into makes impossible a literal translation of the entire conceptual information contained in the original."
> (Jakobson 1959/2004: 234–235)

However, a more careful look into Jakobson's argument shows he that is not claiming that any language *as it exists at any particular time* is always able to express any conceptual content (or "cognitive experience"). Rather, his claim is that any language can be at least appropriately *modified* to achieve this. Sometimes such changes may even need the addition of novel expressions, such as loanwords. It seems, then, that the version of universalism defended by Jakobson is not that languages have infinite expressive power, but rather that languages are not closed systems. They are malleable enough to be changed when needed to increase their expressive power.

Whatever the final verdict on Jakobson's assessment will turn out to be, it is clear that languages can differ in many semantically relevant ways, which is problematic for the strongest variants of universalism. Typological literature is abundant with examples of variation concerning the grammatical marking of semantically interpreted features (Greenberg 1966, Corbett 1991, 2000, Aikhenvald 2000, 2004, Croft 2003, de Haan 2010, Evans 2010, Wiltschko 2014). Cross-linguistic lexical variation has also been documented extensively across literature on contrastive linguistics (Alterberg and Granger 2002, Gonzáles et al. (ed.) 2008, Egan and Dirdal 2017), translation studies (Kristmansson 2018, Large et al. (ed.) 2019), lexicography (Bentivogli et al. 2000, Janssen 2004), and machine translation (Santos 1990, Dorr 1994). In this dissertation, Chapter 6 provides an extensive review of both grammatical and lexical mismatches between Finnish and English.

Some universalist linguistic frameworks allocate variation to the overt expression of features instead of their presence in the grammatical derivation (Sigurdsson 2004, Sigurdsson and Maling 2012, Cinque and Rizzi 2010, 2016). This could allow for more unification in abstract syntax. However, this does not remove significant semantic variation in feature *values* across languages, as attested for e.g. tense (Boroditsky 2001), evidentiality (Aikhenvald 2004), definiteness/specificity (Lyons 1999), number (Corbett 2000), gender (Corbett 1991, Boroditsky et al. 2003), and classifiers (Lakoff 1987, Aikhenvald 2000).

Languages also manifestly differ in their repositories of lexical meanings. Debates in cognitive psychology about linguistic relativity do not concern the existence of semantic variation across languages, but rather the extent of language-dependence within conceptual thought, *given* such semantic variation. This debate has targeted many aspects of conceptual cognition such as color (Berlin and Kay 1969, Saunders 1995), time (Boroditsky 2001), and spatial concepts (Levinson 2003). While lingustic relativism has been both defended and contested in cognitive psychology (Regier et al. 2010, Gleitman and Papafragou 2013), the discussion *assumes* linguistic variation in lexical content. For example, Gleitman and Papafragou (2013) phrase the debate on the influence of color terms on color vision as follows: "(...) there is considerable variance in the number of color terms encoded, so it can be asked whether these linguistic labeling practices affect perception" (p. 507). The existence of variation in lexical content itself is not contested.

Cross-linguistic semantic variation is problematic for translation models that rely on "a completely language-free semantic representation" (Bell 1991: 54), if this is understood as linking the same conceptual structures to all languages. Even if the conceptual system was not language-bound in principle, semantic variation illustrates that languages can be linked to concepts in different ways. While I follow the generative linguistic framework in focusing on universal aspects of cognitive architecture (Chomsky 1965, 1986b), this cannot be done at the expense of empirical credibility. There may well be important restrictions on semantic variation; but strong universalism about linguistic semantics is untenable.

In the remainder of this chapter, I minimize the assumption of shared concepts only to cover functional heads that serve an identical role, such as the Tarskian arrow operators in the T-domain (Chapter 4, Section 4.3.2). For lexical concepts, I assume by default that the source and target concepts are different, as this is the theoretically challenging case. The account developed will also cover shared concepts as special cases.

5.1.2 Linguistic relativism

Another much-discussed but rarely endorsed option is the complete reversal of universalism. Linguistic relativism states that meaning is determined only within a particular language, making cross-linguistic semantic comparison impossible: languages are *semantically incommensurable*. No unambiguous definition of linguistic relativism exists, and the extent to which authors commonly credited with its development (e.g. Humboldt 1836, Boas 1911, Sapir 1921, Whorf 1956) actually maintained it remains debated.[1] In particular, (69a) and (69b) are distinct questions.

(69) a. To what extent do languages differ in the concepts they express?

b. Is the conceptual system divided between languages?

As discussed in Section 5.1.1, (69a) has an empirically attested answer: languages manifest non-trivial semantic differences. However, (69b) does not follow from this. All that is required for (69a) is that *expressions* are (at least in part) language-particular, and connect to conceptual structures in potentially non-overlapping ways across languages. This alone tells us nothing about the division of the conceptual system itself.

A major problem with linguistic relativism arises from its methodological incompatibility with the main evidence used to advance it: the untranslatability of certain expressions between certain languages. As Macnamara (1970) observed, relativism would strictly speaking imply that bilingual speakers were unable to comprehend *their own thoughts* across languages. This is, of course, not *a priori* impossible, as introspective access to many aspects of cognition is limited. However, it would methodologically undermine the arguments used in its favor in the first place, which rely on observed semantic discrepancies between languages.

Consider verifying the untranslatability of some L1-expression E in L2, where L1 and L2 are different languages. This involves reaching the conclusion that no L2-expression is an appropriate translation of E. But since this requires comparing the SEMs of various L2-expressions to SEM(E), relativism would imply that there should be *no fact of the matter* concerning translatability available to the speaker. Since assessments of untranslatability constitute the primary motives for linguistic relativism, it follows that the theory is, in effect, *methodologically self-defeating*.

[1] For a historical overview of linguistic relativism, see Leavitt (2011).

Macnamara's (1970) argument has been suggested to misrepresent the relativist position (Paradis 1979, Bylund 2011: 122). Nevertheless, it illustrates an important requirement for translation: concepts must be able to *interact* in ways that make the relevant semantic comparisons possible in the first place. Concepts cannot be *impenetrable* to those expressed in other languages (House 2016: 48). While they are not invariant across languages, they must still be commensurable to allow translation. Therefore, an approproate theory needs to combine (i) the possibility of variation across concepts linked to different languages, and (ii) the commensurability of such concepts within the conceptual system, giving rise to the kinds of conceptual relations involved in translation.

Furthermore, the argument from relativism to the impossibility of translation can simply be turned around: translation clearly exists, and accounting for it requires concepts to be semantically commensurable across languages. At most, the relativist could argue that translation is in some way *illusory*: translators merely believe that they are translating but they are actually not, as this would involve relating meanings between languages (which relativism deems impossible). From the cognitive perspective adopted in this dissertation, an appropriate reply would be that the "illusion" of translation is precisely the present topic of study. The aim of the dissertation is not to assess whether translation – as an observable human practice – satisfies the criteria for "translation" proposed in some theory. Instead, the aim is to understand the cognitive competence behind translation as it actually exists; whether this turns out to involve e.g. conceptual overlap is a further question. The existence of translation is the starting point, not a research question in itself.

5.1.3 Partial overlap

A view located between universalism and relativism is that concepts can *overlap* in their constitution even if they are not identical. Translation would be possible because conceptual structures can overlap to varying degrees across languages; but this overlap could differ between language pairs, incorporating the kinds of insights that may initially motivate relativism. For example, classical definitionalism (Chapter 4; Section 4.1.2) could account for translation by concepts sharing defining constituents, and this sharing could only be partial, allowing imperfect but nevertheless optimizable translation. This approach was undertaken by Nida (1964, 1975), based on Katz and Fodor's (1963) definitionalist semantics (see Chapter 2, Section 2.3.2). However, it inherits the problems of definitionalism, which has been widely rejected as a credible account of concepts (Fodor et al. 1980, Fodor 1998, Laurence and Margolis 1999, 2003, Murphy 2002, Carey 2009; see Chapter 4, Section 4.1.2).

Currently, a much more popular notion is that linguistic meanings occupy a "semantic space", which is analogue and sensory-motor in nature (e.g. Churchland 1986, 1998, Gärdenfors 2000, 2014). This view is essential to the anti-formalist framework of cognitive grammar (Langacker 1987, Lakoff 1987) and its applications to translation (Tabakowska 1993, Halverson 2009, 2010, Risku 2012, Rojo and Ibarretxe-Antunano (ed.) 2013). It is also suggested in passing by Chomsky (1995a: 8), who mentions the "variability of semantic fields" as an aspect of linguistic variation beyond syntactic parameters.

However, the partial overlap account of translation is incompatible with *conceptual atomism*, which maintains that (lexical) concepts have a formal identity that has no further conceptual interpretation. In order for partial overlap to be possible, concepts would have to be complex in some discrete or analogue manner, such that some proper subset of the constituents of one concept could be shared by another. If constitutive overlap between concepts is needed for translation, atomism can only allow it in the form of full identity. Given the lack of full identity in many cases of lexical variation (see Section 5.1.1), atomism cannot treat these as involving partial conceptual overlap: they are simply non-identical.

Assuming the pointer-based variant of conceptual atomism to be valid (Quilty-Dunn 2020; see Chapter 4, Section 4.2), one option could be to modify the requirement of overlap to cover non-constitutive information stored in Logical or Encyclopedic Entries. Even though concepts are not constituted by e.g. prototypes, overlap in prototypes is still relevant for translation. Similar considerations hold for conceptual roles, sets of exemplars, etc. The idea of a less strict form of "equivalence" in terms of partial overlap of information has been highly influential in translation theory (see e.g. Chesterman 2016).

However, there are two major challenges in identifying translation as overlap between non-constitutive information linked to concepts. The first is that the information considered for overlap can vary greatly between contexts, which makes robust (non-circular) generalizations unavailable. The second is based on the observation that conceptual roles are not *compositional* in the same way as concepts (Fodor 1998, Fodor and Lepore 2002). I further argue that translation relies on compositionality in crucial respects; and, hence, this generalization cannot be captured by overlap in non-constitutive information related to concepts. Consequently, the partial overlap account lacks the ability to explain central properties of translation.

Concepts can overlap in a vast range of properties, which differ in their relevance for translation. Sometimes even very high overlap is insufficient to secure translation, and other times the target expression can vary significantly from the source expression in certain aspects while still constituting an appropriate translation. The Finnish noun *kauppa* can mean a shop or store, as well as a business transaction. The English *shop* completely lacks the latter meaning, and English further differentiates between *shop* and *store* in various ways related to e.g. size. Thus, while *kauppa* and *shop* overlap in certain ways, they diverge in many others. Yet, in many occasions (although not all) they are the most appropriate translations of each other. This cannot be determined by their overlap alone; rather, selecting some *subset* of the overlap in relation to the present discourse is highly relevant.

But describing the selection of which aspects of overlap are the most important is difficult – arguably impossible – in a non-circular manner that avoids reference to the translation task itself. The only generic rule seems to be that translation is based on overlap *to the extent that it makes an appropriate impact on translation*, in the context where the particular translation is made. This generalization, while true, fails to have explanatory power since it makes circular reference to "translation".

The circularity problem is not yet a *reductio* argument against the partial overlap account. One possibility is that translation is simply *too holistic* a phenomenon to fall under any robust non-circular generalizations. For example, due to the open-ended and contextually variable nature of conceptual roles, Fodor and Pylyshyn (2014) conclude that translation is not amendable for proper scientific theorizing. They compare the question of "what is the 'right' translation of a certain text" to "which of two jokes is funnier" or "what, precisely, is the message transmitted in a certain communication"; each being "endlessly sensitive to contextual detail" and hence beyond the scope of scientific analysis (Fodor and Pylyshyn 2014: 76). These remarks are similar to Chomsky's (2000b: 69–70) warning against attempts to construct a "theory of everything". According to Chomsky, the problem with such theories is not that they are false, but that they are *uninformative* (see Chapter 2, Section 2.3.5).

However, in my judgement Fodor and Pylyshyn (2014) are too hasty to conclude that no robust generalizations can be made about translation. Looking more closely at their formulation, they discuss the open-ended nature of "what is the 'right' translation of a certain text". This can be understood as concerning the choice between multiple translation candidates, all considered *roughly correct* but some being more contextually appropriate, given an open-ended range of background information. Such choices are indeed deeply holistic – depending on potentially any available information – and hence incapable of being properly analyzed within a computational approach without succumbing to the *frame problem* (McCarthy and Hayes 1969, Dennett 1987).[2] Nevertheless, this does not mean that no systematic generalizations about translation could be found. In fact, I maintain that there are indefinitely (in fact potentially *infinitely*) many conditional generalizations that fall under the generic form (70):

(70) A translates to B in part because C translates to D

For example, the English phrase *brown dog* translates to *ruskea koira* in Finnish in part because *brown* translates to *ruskea*. Evidently, this is because *brown dog* has *brown* as a constituent in a certain mode of combination, and *ruskea koira* has *ruskea* as a constituent in the same way. The triviality of such examples might underlie why they have rarely been explicitly discussed in translation studies; but explaining their triviality is an important task for cognitive science. As will be seen in Section 5.2.3, this explanation is itself far from trivial. Cases of (70) are valid and robust generalizations about translation, and thus constitute counter-examples to Fodor and Pylyshyn's (2014) claim that statements about translation are always "endlessly sensitive to contextual detail" (p. 76).

Compositionality plays a crucial role in grounding (70). However, information related to a concept is not necessarily compositional, as the "PET FISH problem" demonstrates (Fodor 1998): the concept PET FISH is compositionally constituted by the concepts PET and FISH (via conjunction), but the prototype of a pet fish (e.g. a goldfish) is not compositionally constituted by the prototype of a pet (e.g. a dog) and the prototype of a fish (e.g. a trout). Since the conceptual roles of complex concepts are not reliably compositional, they also cannot explain generalizations of the form (70) when these arise from compositional relations.

In summary, the discussion above has noted three significant problems in the notion that translation could be based on partial conceptual overlap. First, partial overlap between atomic concepts is *ipso facto* impossible, and hence the account does not fit with the atomistic analysis

[2]The frame problem concerns the determination of which parts of background knowledge are relevant for different tasks, given that going through the entire knowledge base would be too computationally demanding. Without circularly entering the same problem again, the selection of relevant knowledge cannot be made by going through the entire knowledge base and determining which parts are relevant. Notably, despite otherwise differing drastically in their approaches to the philosophy of mind, both Dreyfus (1972) and Fodor (1983, 2000) have argued that the frame problem constitutes an insurmountable obstacle for symbolic computation, and illustrates the non-computational status of relevance determination.

of concepts adopted in Chapter 4 (Section 4.2).[3] Incorporating it would thus require basing translation on overlap between non-constitutive information related to concepts. However, this results in two major issues: (i) deciding which information is relevant for determining the overlap in any particular translation context; and (ii) accounting for generalizations of the form (70) that obtain due to *compositional* relations within the source and target SEMs. The first of these concerns might initially lead to denying the existence of robust generalizations about translation, as proposed by Fodor and Pylyshyn (2014). However, the compositionality of SEMs makes cases of (70) ubiquitous.

5.2 Translation as inter-lingual inference

Sections 5.1.1–5.1.3 argued that conceptual overlap is unsatisfactory as the basis of translation: strong universalism and linguistic relativism are both empirically untenable from the start, and partial overlap fails at important requirements for a cognitive account of translation. Even though the possibility of some (perhaps many) concepts being shared across languages remains a valid hypothesis, a credible theory cannot rely on it as the *only* means by which translation can be attained. This goes against the seeming truism that translation involves "the same meanings" between source and target expressions. In contrast, I maintain that the conceptual relation that obtains between source and target SEMs in translation does not – at least in principle – require *any* constitutive overlap between them. The present section proposes an alternative account of translation as a variant of *inference*. Section 5.2.1 clarifies the distinction between constitutive and inferential relations between concepts. Section 5.2.2 lays out the notion of *immediate entailment* as the relevant relation for grounding translation, which Section 5.2.3 extends to *compositional translation* between complex phrases.

5.2.1 Constitutive vs. inferential relations

In the framework on concepts presented in Chapter 4 (Section 4.2), memorized relations between concepts are stored in Logical or Encyclopedic entries, which are partitions of the memory location addressed by the concept. These are not constitutive of the concept, which is why

[3] Of course, conceptual atomism still allows partial overlap between *complex* concepts. Some constituent concepts might be identical and others non-identical between two complex concepts. However, this is obviously insufficient to account for translation, which also needs to be specifiable between expressions that bear non-identical atomic SEMs.

it is possible for conceptual identity to be retained across changes to its entries. In contrast, complex concepts are built from other (complex or atomic) concepts via various modes of combination (such as predication, connectives, or quantification). By definition, a complex concept bears a constitutive relation to the concepts it contains.

The constitutive relation between a complex concept and its parts can be contrasted to *inferential* relations between an atomic concept and the contents of its Logical or Encyclopedic Entry. As a first approximation, inferential relations determine which concepts are judged to be applicable based on other concepts. Notably, while constitutive relations play an important role in fixing inferential relations (see Section 5.2.3), two concepts can also bear an inferential relation even if they are constitutively unrelated. Conceptual relations between two distinct atomic concepts cannot be constitutive and hence must be inferential,[4] whereas relations between complex concepts can be either inferential or constitutive (or both).

As an example, the belief that water boils at 100°C is typically acquired after the concept WATER has been introduced to the conceptual system. There is no need to treat this conceptual relation as constitutive of the concepts WATER, CELSIUS-DEGREE, etc. Glossing over the analysis of 'boils at 100°C' for simplicity, the conceptual relation can be analyzed as an *entailment*: WATER $\Rightarrow$ BOILS-AT-100°C.[5] It licences the inference from something being water to it boiling in 100°C, without any overlap between the respective concepts. This information could be stored e.g. in the Encyclopedic Entry of WATER.

The distinction between constitutive and inferential relations has previously been discussed in the context of interpreting *category-specific semantic deficits*, where the location of brain damage deteriorates different aspects of conceptual knowledge (Hillis and Caramazza 1991, Damasio 1999, Capitani et al. 2003). Opposing the prevalent view that these deteriorate different semantic features from which concepts are constructed (e.g. Rapp and Caramazza 1991, Smith 1995), de Almeida (1999) proposes an alternative inference-based account. This bears important similarities to my analysis of translation.

Accepting a variant of conceptual atomism (based on Fodor 1998), de Almeida (1999) defines the *inferential domain* of a concept X as the set of inferences caused by X, together with the set of inferences that involve other concepts but entail something also entailed by X (p. 243). As a simple example, we can consider the following set of inferential relations:

[4]Concepts can also be *associatively* related without an intrinsic conceptual interpretation (Fodor 1998: 10).

[5]I use "$\Rightarrow$" to denote entailment, distinct from the the logical implication connective ("$\rightarrow$"). For the lack of entailment, I use "$\not\Rightarrow$". Importantly, A $\not\Rightarrow$ B should not be conflated with A $\Rightarrow \neg$B.

DOG $\Rightarrow$ ANIMAL

CAT $\Rightarrow$ ANIMAL

Of these, DOG $\Rightarrow$ ANIMAL involves DOG directly. Furthermore, in CAT $\Rightarrow$ ANIMAL, the entailed concept (ANIMAL) is also entailed by DOG. Therefore, both inferences are in the inferential domain of DOG. Based on this, de Almeida argues that category-specific deficits arise when difficulty in activating one concept affects the processing of concepts involved in its inferential domain. Hence, a difficulty of processing DOG will likely affect the processing of CAT, even though there is no *constitutive* relation between these concepts (given atomism).

While I leave further assessment of de Almeida's specific analysis for further research, it provides an important exception to the widespread acceptance of constitution-based accounts of conceptual capacities in the cognitive psychology literature. It also serves as an example of how *inferential relations can replace constitutive relations* as the main semantic *explanans* within the framework of conceptual atomism. I extend this line of analysis to cover translation.

Specifically, I propose that translation should be considered as a variant of *inter-lingual inference*, as defined in (71).

(71) **Inter-lingual inference:**

Let C_1 and C_2 be (simple or complex) concepts.

Let $\mathbf{L_i}$ be the set of all grammatical expressions in language $L_i \in \{L_1, L_2\}$.

Inference from C_1 to C_2 is inter-lingual iff:

1. $\exists \text{S}_1 \in \mathbf{L_1}$ such that $\text{SEM}(\text{S}_1) = \text{C}_1$
2. $\exists \text{S}_2 \in \mathbf{L_2}$ such that $\text{SEM}(\text{S}_2) = \text{C}_2$

Chapter 3 proposed a novel analysis of linguistic differentiation within a bilingual I-language, where "languages" are assimilated to maximal groups of positively connected PF-rules (Section 3.3.3). Applying this to (71), $\mathbf{L_1}$ and $\mathbf{L_2}$ can be defined as sets of syntactic objects that can be pronounced with one such group of PF-rules ($\mathbf{L_1}$) or another ($\mathbf{L_2}$). Based on this, it now becomes possible to analyze translation without relying on either "languages" or the "sameness of meaning" as unanalyzed theoretical primitives.

If linguistic differentiation is PF-based, the notion of "language" is not even available for SEMs. Importantly, however, this does not mean that SEMs could not be indirectly language-specific by virtue of being linked to expressions that are pronounceable via one but not another group of PF-rules. Therefore, the present analysis combines the two main *desiderata* laid out in Section 5.1: concepts can be language-specific, but this does not remove their *commensurability* across languages.

Definition (71) also does not rule out the possibility that $\mathrm{C}_1 = \mathrm{C}_2$, in which case the concept is shared between the two languages. Since every concept can trivially be inferred from itself, such cases of shared concepts are covered by the inter-lingual inference account of translation as a special case. Hence, concept-sharing can still ground translation when available. The novelty of the inference-based account is that shared concepts are not *required*.

However, only stating that translation is a variant of inter-lingual inference is insufficient, as inference is too broad a notion to restrict translation appropriately. Which further restrictions should be needed is the topic of Section 5.2.2.

5.2.2 Immediate entailment

I suggest that translation involves an inferential relation I call *immediate entailment*. I arrive at this by first considering and rejecting two alternatives: *equivalence* and *entailment*. The first is too strict and second too allowing. The main goal is to optimize two properties of the target SEM: *informativity* and *conservativity*:

Informativity: maximization of entailments shared with the source SEM
Conservativity: minimization of entailments not shared with the source SEM

Informativity requires that what is entailed by the source expression should also be entailed by the target – to the extent possible in the target language. Conservativity means avoiding the introduction of novel content that does not follow from the source. Often one of these two must give in, and in some cases neither can be fully satisfied. Nevertheless, I propose that translation aims at maximizing both. The question is, thus, how to restrict inter-lingual inference in a way that achieves this.

As a first option, *equivalence* would maximize both informativity and conservativity perfectly. It trivially obtains between a concept and itself, securing translation in the special case of conceptual identity. However, it can also hold between non-identical concepts. Suppose an English-German bilingual speaker has different concepts for the words *dog* and *Hund*: DOG and HUND. She can still believe each entails the other: DOG $\Rightarrow$ HUND and HUND $\Rightarrow$ DOG. This amounts to DOG an HUND's equivalence: whatever is true of one is also true of the other (according to the speaker's conceptual system).

Equivalence also permits paraphrasal translations and circumlocutions, where the translation changes the grammatical structure. Consider the English translation of the German noun *Lehrerin* as *woman teacher*. Here, there is no 1–1 correspondence between the grammatical structures of the source and target expression. Rather, the translation can be explained by the equivalence LEHRERIN $\Leftrightarrow$ TEACHER $\wedge$ WOMAN. Since the SEM of *woman teacher* corresponds to the right-hand side, it is an appropriate translation.

However, equivalence is a relatively rare state of affairs (albeit plausibly more common than the identity between source and target SEMs). As a prerequisite for translation it is therefore too strict. Lexical discrepancies between languages commonly result in *imperfect* translations that are non-equivalent but nevertheless optimal in the discourse. Here, translation is faced with the task of balancing between the opposing forces of informativity and conservativity, without being able to retain both completely. Therefore, equivalence is appropriate for translation when available, but further means are needed in its absence.

Loosening the requirement of equivalence, one possibility could be only to require *entailment*. Here, informativity is compromised but conservativity is maintained. For example, the English nouns *shop* and *store* both translate to *kauppa* in Finnish, where the target loses information concerning the distinction between the two possible English words. While *kauppa* is equivalent with neither *shop* nor *store*, it is nevertheless entailed by both.[6]

However, entailment is too liberal. The source expression entails multiple concepts available in the target language, most of which are inappropriate as translations. For instance, *shop* entails not only *kauppa* in Finnish, but also e.g. *rakennus* ('building'), *asia* ('entity'), and a myriad of other Finnish expressions that are evidently not correct translations. In fact, the source always trivially entails an *infinite* amount of concepts. If A entails B, it also entails the disjunction B $\vee$ C for any C. While this may seem like a trivial logical detail, the theory should explain why e.g. *kauppa tai koira* ('shop or dog') is not an appropriate translation of *shop*, even though *shop* entails it.

The issue evidently has to do with informativity. *Kauppa* is the best translation of *shop* because (i) it is entailed by *shop*, and (ii) of all Finnish expressions entailed by *shop*, it is the *most informative*. This notion can be clarified as follows. Suppose A entails both B and C. Suppose further that B also entails C but not vice versa. This means that the extension of B

[6]For convenience, I talk about expressions entailing others, even though these relations actually obtain between their SEMs.

is smaller than that of C, making B more specific and hence more informative than C. We can say that while A entails both B and C, it only *immediately entails* B.

Immediate entailment, defined in (72), thus *maxizes informativity among entailed concepts*. It can further be restricted to a *target domain*, which is a set of concepts that are considered for assessing the relevant entailment relations.

(72) **Immediate entailment:**

A immediately entails B in domain δ iff:

a. A $\Rightarrow$ B

b. B $\in \delta$

c. $\neg\exists$X $\in \delta$ such that:

  i. A $\Rightarrow$ X

  ii. X $\Rightarrow$ B

  iii. B $\not\Rightarrow$ X

Going back to the example above, only *kauppa* is immediately entailed by *shop* in the target domain of SEMs expressible in Finnish. For instance, even though e.g. *rakennus* ('building') is entailed by *shop*, it is also entailed by *kauppa* but does not entail *kauppa*. Therefore, *shop* does not immediately entail *rakennus* in the Finnish target domain.

Importantly, restrictions (i)-(iii) in (72c) only apply within the target domain δ. Outside δ, the source A may entail some concept that is more informative than B; but only target candidates in δ are considered for determining immediate entailment in δ. Notably, A itself does not need to belong to δ, although it can.

Immediate entailment is thus more liberal than equivalence, but maximizes informativity unlike mere entailment. It is now possible to reformulate the analysis of translation to require immediate entailment. This is done in (73), where the domain of language L is the set of SEMs linked to grammatical expressions of L.

(73) Expression E_1 translates to E_2 in language L iff:

a. SEM(E_1) = C_1

b. SEM(E_2) = C_2

c. C_1 immediately entails C_2 in the domain of L

That its, translating E_1 involves finding E_2 such that SEM(E_1) immediately entails SEM(E_2) in the target domain consisting of the SEMs of all target language expressions.

An important property of immediate entailment is that it is secured by equivalence. This is proven by *reductio ad absurdum* of its negation in (74).

(74) Let A and B be concepts where A $\Leftrightarrow$ B, and let δ be a domain where B $\in \delta$.
Assumption: A does not immediately entail B in δ. Then $\exists$X $\in \delta$ such that:

1. A $\Rightarrow$ X (from the definition of immediate entailment)
2. X $\Rightarrow$ B (from the definition of immediate entailment)
3. B $\not\Rightarrow$ X (from the definition of immediate entailment)
4. B $\Rightarrow$ A (from A $\Leftrightarrow$ B)
5. B $\Rightarrow$ X (from 4 and 1)
6. B $\Rightarrow$ X and B $\not\Rightarrow$ X (from 5 and 3)

The assumption leads to a contradiction and is thus false.
Therefore, A immediately entails B in δ.

Furthermore, if an equivalent target concept is available, no non-equivalent concept is immediately entailed by the source. That is, if A is equivalent with B, it can only immediately entail C if it is also equivalent with C. This is proven in (75):

(75) Let A, B, and C be concepts and δ be a domain, where A $\Leftrightarrow$ B and $\{\mathrm{B}, \mathrm{C}\} \subseteq \delta$.
Assumption: A immediately entails C in δ. Then:

1. A $\Rightarrow$ B (from A $\Leftrightarrow$ B)
2. A $\Rightarrow$ C (from the definition of immediate entailment)
3. B $\Rightarrow$ C (from A $\Leftrightarrow$ B and 2)
4. If C $\not\Rightarrow$ B, then $\exists X \in \delta$ where A $\Rightarrow$ X, X $\Rightarrow$ C, and C $\not\Rightarrow$ X (from 1 and 3)
5. If C $\not\Rightarrow$ B, then A does not immediately entail C in δ (from 4 by definition)
6. C $\Rightarrow$ B (from 5 via *reductio ad absurdum*)
7. B $\Leftrightarrow$ C (from 3 and 6)
8. A $\Leftrightarrow$ C (from A $\Leftrightarrow$ B and 7)

Together, (74)–(75) prove that (73) requires an equivalent target if one is available. Hence, a non-equivalent target can only be chosen if no equivalent targets are present in the target domain. Since every expression is trivially equivalent with itself, (73) also guarantees that a concept can be translated to itself if it belongs to the target domain. However, there is no guarantee that the identical target candidate is chosen over some other equivalent target.

Immediate entailment is *indeterministic*: many concepts can be immediately entailed in a target domain. This is clear in the case of equivalent concepts: if there are multiple equivalent target candidates, (73) gives no basis for selecting between them. This accords with the observation that translation often involves decisions that have to do with pragmatic, stylistic, and other considerations beyond conceptual content alone. Hence, (73) only specifies a *necessary* rather than a *sufficient* condition for translation: it restricts possible targets to those that are immediately entailed by the source, but further considerations are needed for deciding between these. Such selection generally involves multifaceted considerations that evade computational explanation (see Section 5.1.3).

Furthermore, immediate entailment can be indeterministic even between non-equivalent target candidates. For example, suppose that $\delta = \{\textsc{woman}, \textsc{teacher}\}$, and the only entailment relations considered are LEHRERIN $\Rightarrow$ WOMAN and LEHRERIN $\Rightarrow$ TEACHER. Here, LEHRERIN immediately entails two non-equivalent concepts in δ: WOMAN and TEACHER. However, there is a fundamental restriction on indeterministic immediate entailment that arises when a further condition is introduced for the target domain. This can be called *conjunctive closure*, and is defined in (76).

(76) **Conjunctive closure:**
If A immediately entails both B and C in domain δ, then A immediately entails B $\wedge$ C in domain $\delta \cup \{B \wedge C\}$.

Conjunctive closure follows from two logical principles: (i) if A immediately entails both B and C, then it entails B $\wedge$ C; and (ii) B $\wedge$ C is always at least equally informative to B or C alone, and can be more informative. It also follows from (76) together with (75) that if the target domain already contains all conjunctions of its atomic concepts, immediate entailment can only be indeterministic between *equivalent* target concepts.

The relevance of conjunctive closure can be illustrated with the translation example discussed above: translating the German *Lerherin* to *woman teacher* in English. Here, we have the following entailments: LEHRERIN $\Rightarrow$ TEACHER, LEHRERIN $\Rightarrow$ WOMAN, and LEHRERIN $\Rightarrow$ TEACHER $\wedge$ WOMAN. Since WOMAN and TEACHER do not entail each other to either direction, neither is immediately entailed by LEHRERIN if their conjunction is available. The conjunction specifies a more restricted extension than either concept itself – i.e. is more informative than either of its conjuncts alone. In contrast, if the conjunction is not in the target domain, both WOMAN and TEACHER are immediately entailed by LEHRERIN indeterministically. In this case, both *woman* and *teacher* are *prima facie* candidates for the translation of *Lehrerin*, and the decision between them must be made on other grounds.[7]

Summarizing the discussion so far, I introduced immediate entailment between source and target SEMs as the condition for translation. This is guaranteed by equivalence between the SEMs, and hence also by their identity. If an equivalent target candidate is available, no non-equivalent candidates are immediately entailed. Multiple candidates can be immediately entailed, and the choice between these is made by further (possibly non-computational) cognitive processes. All equivalent target concepts are immediately entailed, but multiple non-equivalent concepts can also be. Adding the conjunction of immediately entailed concepts to the target domain secures the immediate entailment of the conjunction. Next, I move on to discussing cases where translation adds information and hence fails to respect entailment on its own.

Immediate entailment accounts for cases where the target is equally or less informative than the source. In equivalence, the source and target entail each other; and with non-equivalent targets, the target is less informative than the source. The latter allows *convergent translation* in the terminology of Levý (1967), where multiple sources can translate to the same target (see Chapter 2, Section 2.3.3). As an example of such many-to-one translation, both the German *Lehrer* and *Lehrerin* translate to *teacher* in English, where gender information is lost.

However, immediate entailment alone fails in cases where the target expression is *more* informative than the source. Here, the source expression does not entail the target expression at all. Consider translating the English *teacher* to either *Lehrerin* or *Lehrer* in German. Neither target is entailed by the source, but one of them is typically an appropriate translation. This exemplifies what Levý (1967) called *divergent translation*, where a single source can take multiple targets in different contexts.

Divergent translation requires taking additional *discourse information* into account. For instance, if the discourse specifies that Mary is a woman, then *Lehrerin* is an appropriate German translation of *teacher* when it is predicated of Mary. Another example is given in (77), taken from the English-Finnish corpus of the OpenSubtitles2016 collection.[8] The original sentence (77a) is translated to (77b) (with my glosses and literal translation added), and here I only focus on the translation of *kid* to *poika*:

[7] An example context where *woman* could potentially be a better translation than *teacher* would be one where every relevant person in the discourse is a teacher but only one of them is a woman.

[8] `http://opus.lingfil.uu.se/OpenSubtitles2016.php` (Tiedemann 2012) (derived from `https://www.opensubtitles.org/fi`).

(77) a. If your **kid** beats my brother, then I 'm going to beat you

b. Jos **poikasi** voittaa veljeni, hakkaan sinut
if son.2SG-GEN win.3SG.PRES brother.1SG-GEN beat.1SG.PRES 2SG.ACC
'If you son wins my brother, I will beat you'

The Finnish noun *poika* would literally translate to the English *boy* or *son*. The word *kid*, on the other hand, is not inherently gendered. Thus, *kid* is translated to *poika* even though the concept KID does not entail the concept POIKA. The translator seems to have known (or at least assumed) that the entity KID predicates in the discourse is a boy. With the addition of this background information, immediate entailment between KID and POIKA can hold.

An initial possibility would thus be to relativize immediate entailment to a discourse **D**, which is a set of propositions the speaker is committed to at the utterance time.[9] Here, A immediately entails B given **D** if A together with some content of **D** immediately entails B. For example, if **D** specifies Mary to be a woman and TEACHER is predicated of her, this would licence immediate entailment from TEACHER to LEHRERIN given **D**. The relativization of immediate entailment to a discourse is formalized in (78):

(78) **Immediate entailment in a discourse:**
A immediately entails B in domain δ given discourse **D** iff:
$\exists$X $\in$ **D** such that A $\wedge$ X immediately entails B in δ

However, a problem arises if immediate entailment is simply relativized to all possible discourse contents, as specified in (78). This would allow numerous inappropriate translations, which add *superfluous* information. Suppose **D** contains both the information that Mary is a woman and the information that she is 40 years old. Adding these to the SEM of *teacher* yields TEACHER $\wedge$ WOMAN $\wedge$ 40-YEARS-OLD, which immediately entails LEHRERIN $\wedge$ 40-JÄHRIGE. Yet, *teacher* does not translate to *40-jährige Lehrerin* in German, even if the discourse specified the age of the teacher in question as 40 years old.

The issue is clearly that the use of additional discourse information should be *minimized*, in line with the principle of *conservativity* (see the beginning of this section). The SEM of *40-jährige Lehrerin* is conjunctive: LEHRERIN $\wedge$ 40-JÄHRIGE. Furthermore, one of the conjuncts is only introduced by the additional discourse information (40-JÄHRIGE). Hence, dropping

[9]The speaker commits to the discourse – i.e. treats as if it were true – even in *pretence* contexts, despite these being actually considered counter-factual (Nichols and Stich 2000, 2003). The absence of proposition P from **D** does not equal the presence of $\neg P$ in D; that is, the *closed world assumption* does not hold of **D**.

it reduces the use of discourse information and thereby enhances conservativity. In contrast, the addition of gender information (the masculine LEHRER vs. the feminine LEHRERIN) is required by the target language grammar. Its addition is compelled by the nature of the target language, whereas the addition of 40-JÄHRIGE is superfluous.

I propose that the conservativity principle manifests as a general preference toward discarding superfluous conjunctive discourse information. If some conjoined concept is removable without sacrificing immediate entailment in the discourse as specified in (78), it is shunned. This preference is stated more formally in (79):

(79) **Avoid superfluous discourse information:**
If A immediately entails both B_1 and $B_1 \wedge B_2$ in domain δ given discourse **D**, choose B_1 over $B_1 \wedge B_2$.

Divergent translation can now be analyzed as maintaining immediate entailment in the discourse – as specified in (78) – while avoiding the addition of superfluous discourse information – as specified in (79). Notably, I am not making any proclamations about when translators might choose to engage in divergent translation over convergent translation, or which specific pieces of discourse information are considered. The case of *teacher–Lehrerin* has to do with the mandatory gender-marking in German noun phrases. On the other hand, (77) exemplifies divergent translation that lacks such a grammatical motivation. Principle (79) only states that *if* two candidates are considered where one contains a superfluous conjoined concept and the other does not, the latter is preferred. The questions of *when* and *why* such comparison is actually performed goes beyond the present analysis.

Before moving on to the translation of complex phrases, I summarize the main contents of the present section. First, translation was analyzed as finding a target expression (the SEM of) which is immediately entailed by (the SEM of) the source expression within the domain of possible target concepts. Immediate entailment is secured by the equivalence – and hence also by the identity – of the source and target. Beyond equivalence, there are two ways to proceed, which relate to convergent or divergent translation, respectively (Levý 1967). In the first variant, the target is entailed by the source but not vice versa. Here, immediate entailment ensures that the *most informative* target is chosen. In the second variant, the target is more informative than the source, and hence immediate entailment between them does not hold. Here, the source is appended with additional discourse information, such that their conjunction immediately entails the target. This added information is limited to the minimum in accordance with principle (79). While divergent translation necessitates reliance on the discourse, (79) ensures that superfluous discourse information is shunned.

The present analysis makes translation indeterministic in three main ways: (i) multiple targets can be immediately entailed; (ii) the choice between convergent and divergent information is not determined; and (iii) the discourse information considered in divergent translation is not determined. This is not a theoretical shortcoming, as translation evidently involves many considerations or e.g. pragmatics and style, which go beyond conceptual relations alone. As elaborated in Chapter 2 (Section 2.1), my account of translation is not intended to provide a full causal pipeline for translation *performance*, but instead to account for the cognitive *competence* underlying the possibility of such performance.

5.2.3 Translation of complex phrases

Example translations discussed in the preceding sections have concerned lexical content. However, the analysis of translation as immediate entailment can be extended to phrasal translation as well. In this section I combine this with the syntax-semantics interface theory outlined in Chapter 4.

There is an important distinction between the translation of complex expressions via their *compositional* meanings, and the translation of syntactic heads or phrasal idioms. The cognitive capacity that allows us to compose novel complex concepts from simple constituents also allows us to translate genuinely novel complex expressions, which makes translation *productive*. This can be called *compositional translation*, and conversely non-compositional translation can be called *idiomatic*. (It technically follows that the translation of expressions with atomic SEMs is *ipso facto* idiomatic.)

A general characterization of compositional translation is provided in (80):

(80) **Compositional translation (version 1)**:

T is a compositional translation of S iff:

a. T is a translation of S

b. S is constituted by S_1 and S_2

c. T is constituted by T_1 and T_2

d. T_1 is a translation of S_1

e. T_2 is a translation of S_2

Roughly, translation is compositional if translations of the source's constituents are the target's constituents. While (80) does not explicitly mention either grammatical or conceptual modes of combination, these are indirectly implicated in condition (80a), which requires the complex target to translate the complex source. Conditions (80b–e) alone could not account for why e.g. the Finnish *Merja näki Pekan* is translated to *Merja saw Pekka* and not *Pekka saw Merja* in English. However, even though both target candidates fulfil (80b–e), only the first is a translation of the source sentence and thus fulfils all conditions (80a–e).

Given the compositionality of SEMs, there is an indefinitely large number of generalizations concerning the translation of complex expressions by virtue of compositional translation. Examples are not hard to find: e.g. the Finnish *ruskea koira* translates to *brown dog* in part because *ruskea koira* has the constituents *ruskea* and *koira*, *brown dog* has the constituents *brown* and *dog*, *brown* translates to *ruskea*, and *dog* translates to *koira*. Such generalizations are on par with generalizations about compositionality itself: e.g. that the SEM of *brown dog* is in part determined by the SEMs of *brown* and *dog*. The availability of compositional translation is thus a central aspect of human translation competence.

Notably, the standard conceptual overlap account of translation fails to cover compositional translation (see Section 5.1). Prototypes, conceptual rules, etc. do not guarantee compositionality, as illustrated by the "pet fish" problem (Fodor 1998, Laurence and Margolis 1999, Fodor and Lepore 2002; see Chapter 4, Section 4.1.3). Yet, compositional dependencies are ubiquitous in translation: for example, the Finnish translation of *pet fish* is *lemmikkikala*, where *lemmikki* is the translation of *pet* and *kala* is the translation of *fish*. Since the compositional SEM of *pet fish* is not based on prototypes, neither is its compositional translation.

When combined with the analysis of translation as immediate entailment, (80) can be reconstructed as (81).

(81) **Compositional translation (version 2)**:

T is a compositional translation of S in domain δ given discourse **D** iff:

a. SEM(S) immediately entails SEM(T) in δ given **D**

b. S is constituted by S_1 and S_2

c. T is constituted by T_1 and T_2

d. SEM(S_1) immediately entails SEM(T_1) in δ given **D**

e. SEM(S_2) immediately entails SEM(T_2) in δ given **D**

Conversely, if any condition in (81a–e) is not fulfilled, compositional translation is not instantiated. Given the syntax-semantics interface theory outlined in Chapter 4 (Section 4.3), it is possible to assess (81a–e) in light of the modes of SEM-combination linked to different syntactic domains. To recap, I proposed the following SEM-correlates for each domain:

Domain 1: conjunctive SEMs of type <M>

Domain 2: SEMs of type <M> formed via predicate modifiers

Domain 3: linking the SEM to something outside the extended projection

Beginning with Domain 1, let us make the following assumptions: the source expression is a conjunction $A_1 \wedge A_2$, the target expression is a conjunction $B_1 \wedge B_2$, and immediate entailment holds between the pairs $A_1 - B_1$ and $A_2 - B_2$. Given this, we can now ask whether immediate entailment also holds between the conjunctive source and target. If the answer was a simple 'yes', this would secure compositional translation in Domain 1. However, the situation is more complex.

The first requirement for immediate entailment is entailment itself. This is clearly secured by the assumptions outlined above. If A_1 immediately entails B_1 and A_2 immediately entails B_2, then $A_1 \wedge A_2$ entails $B_1 \wedge B_2$. Negating either B_1 or B_2 would trivially result in a contradiction. The more challenging requirement for immediate entailment is the lack of a more informative target concept than $B_1 \wedge B_2$. These are possible in some cases.

As a toy example for illustration, suppose that the target language is English with the word *cow* removed, and the source expression is the Finnish *nuori lehmä*. Normally, *nuori* translates to *young* and *lehmä* translates to *cow*. Since *cow* is unavailable, the target immediately entailed by *lehmä* in this defective variant of English would be something with a wider extension than *cow*, such as *farm animal*. However, suppose that the word *calf* was still available in the target domain. Since *young cow* and *calf* are (roughly) equivalent, *nuori lehmä* would translate to *calf*. Here, *nuori lehmä* would have an immediately entailed target which is not based on the immediate entailments of its constituents. The relevant immediate entailments are shown in (82), where the lack of COW in the target domain is indicated with strikethrough:

(82) NUORI $\Rightarrow$ YOUNG

~~LEHMÄ $\Rightarrow$ COW~~

LEHMÄ $\Rightarrow$ FARM-ANIMAL

NUORI $\wedge$ LEHMÄ $\Rightarrow$ CALF

In (82), NUORI immediately entails YOUNG and LEHMÄ immediately entails FARM-ANIMAL (due to the absence of COW); but NUORI $\wedge$ LEHMÄ does not immediately entail YOUNG $\wedge$ FARM-ANIMAL since the more informative CALF is available in the target domain. This simple example shows that the immediate entailment of a conjunctive source is not always secured by the immediate entailments of its constituents.

Crucially, idiomatic translation depends on the availability of the relevant kind of additional inference, such as NUORI $\wedge$ LEHMÄ $\Rightarrow$ CALF in (82). Based on this, the conditional generalization (83) can be made (leaving out the background discourse **D** for notational simplicity):[10]

(83) For concepts $\{A_1, A_2, B_1, B_2\}$ and a domain δ: if

a. A_1 immediately entails B_1 in δ

b. A_2 immediately entails B_2 in δ

c. $\neg\exists X \in \delta$ such that:

i. $A_1 \wedge A_2 \Rightarrow X$

ii. $X \Rightarrow B_1 \wedge B_2$

iii. $B_1 \wedge B_2 \not\Rightarrow X$

then $A_1 \wedge A_2$ immediately entails $B_1 \wedge B_2$ in δ.

That is, immediate entailment obtains between a conjunctive source and a conjunctive target by virtue of immediate entailments between their respective constituents, *unless* additional information specifies otherwise. Due to the finitude of such additional information storable in memory, the availability of a concept that would function as X in condition (83c) is not guaranteed for any *arbitrary* pair of concepts (A_1 and A_2) that can be conjoined. This secures the *default* status of $B_1 \wedge B_2$ as the immediate entailment of $A_1 \wedge A_2$, given immediate entailment between the pairs $A_1{-}B_1$ and $A_2{-}B_2$.

Consequently, while cases like the artificial CALF example in (82) are possible, they are *exceptional* not only in a statistical but also a *computational* sense: they rely on specifically memorized inferences that are unavailable for most pairs of conjoinable concepts. While CALF is available in NUORI $\wedge$ LEHMÄ $\Rightarrow$ CALF, there is no corresponding case for most other concepts LEHMÄ could be conjoined with. For example, there are no concepts analogous with CALF for e.g. cows of different colors, sizes, geographical locations, etc. In such cases, immediate entailment falls back to the conjunctive default option.

[10]In (82), A_1 corresponds to NUORI, A_2 to LEHMÄ, B_1 to YOUNG, B_2 to FARM-ANIMAL, and X to CALF.

The analogy to *elsewhere cases* in Vocabulary Insertion is rather transparent (see Chapter 3, Section 3.1.8). These are chosen in the absence of more specific Vocabulary Items pertaining to the same syntactic object in the relevant syntactic context. Similarly, in (83), $\mathrm{B}_1 \wedge \mathrm{B}_2$ is chosen as the immediate entailment of $\mathrm{A}_1 \wedge \mathrm{A}_2$ in the absence of more specific inferences of the form $\mathrm{A}_1 \wedge \mathrm{A}_2 \Rightarrow \mathrm{X}$, given immediate entailment between the pairs $\mathrm{A}_1 - \mathrm{A}_2$ and $\mathrm{B}_1 - \mathrm{B}_2$.

Importantly, elsewhere cases have a special relation to linguistic *productivity*. In Vocabulary Insertion, the English regular plural marker (*-s*) is used by default for nouns unless additional information about their irregular plural marking is explicitly memorized.[11] This allows novel nouns to be inflected in plural without separately memorized information about how this is achieved. Similarly, the default status of conjunctive immediate entailment allows finding the immediate entailment of a conjunctive source SEM even in contexts where no additional information is available on its immediate entailment relations beyond those of its conjuncts. This makes possible the *productive translation* of an arbitrary conjunctive source.

Section 5.1.3 raised generalizations of the form (70) as central *explananda* for a cognitive account of translation, repeated below as (84):

(84) A translates to B in part because C translates to D

We have now uncovered a major source of such generalizations: the default status of conjunctive targets as immediate entailments of conjunctive sources, based on immediate entailment between their respective constituents. This accounts for why e.g. the fact that *brown dog* translates to *ruskea koira* in Finnish is evidently related to *brown* translating to *ruskea* and *dog* translating to *koira*.

It is a reasonable conjecture that immediate entailment should play an important role in the translation of Domain 2–3 SEMs as well. However, due to their wide and potentially open-ended range across languages, proving this conclusively is not a realistic option in this dissertation. With respect to Domain 2, I will specifically discuss immediate entailment with respect to *T-concepts* derived via *arrow operators* (see Chapter 4, Section 4.3.2).

Considering the "positive" arrow operator first, the T-concept $\Uparrow P(x)$ applies to everything if $P(x)$ applies to something; i.e. if $\exists x P(x)$. Therefore, if $P(x)$ entails $Q(x)$, then $\Uparrow P(x)$ entails $\Uparrow Q(x)$. Since whatever satisfies $P(x)$ also satisfies $Q(x)$, it follows that if $\Uparrow P(x)$ applies to everything, then so does $\Uparrow Q(x)$. Furthermore, the peculiar nature of T-concepts trivially

[11] This productivity of regular inflection is the basis of the classical "wug" experiment (Berko 1958), as well as much of overregularization in language acquisition (see e.g. Yang 2016).

secures immediate entailment by entailment alone: $\Uparrow P(x)$ necessarily immediately entails *everything* it entails. T-concepts always apply to everything if they apply to anything. Thus there cannot be two T-concepts with different non-zero extensions, and hence no "intervening" concept to prevent immediate entailment between two T-concepts. All T-concepts that apply to something are truth-functionally *equivalent*, and equivalent concepts immediately entail each other, as shown by the proof (74) in Section 5.2.2. Consequently, if $P(x)$ immediately entails $Q(x)$, then $\Uparrow P(x)$ is equivalent with, and hence also immediately entails, $\Uparrow Q(x)$.

However, while immediate entailment between $P(x)$ and $Q(x)$ results in immediate entailment between $\Uparrow P(x)$ and $\Uparrow Q(x)$, this seems rather artificial since immediate entailment is also guaranteed between $\Uparrow P(x)$ and $\Uparrow Q'(x)$ for *any* Q' where $\exists x Q'(x)$. For example, $\Uparrow P(x)$ also immediately entails $\Uparrow(x = x)$ and all other tautological predicates. The question is, thus, how to account for the preference for $\Uparrow Q(x)$ over e.g. $\Uparrow(x = x)$ in translation, given that both are immediately entailed by $\Uparrow P(x)$.

Evidently, the issue concerns whether the translation is *compositional*: what makes the immediate entailment between $\Uparrow P(x)$ and $\Uparrow Q(x)$ unique is that they are composed of $P(x)$ and $Q(x)$, which enter into an immediate entailment relation. Some kind of a priority given to compositional translation thus seems needed as an addition to the present account. With respect to T-concepts, compositional translation constitutes "translation proper". Admittedly, this explanation is not fully satisfactory, as it simply incorporates preference for compositional translation as an axiom instead of deriving it from independently grounded principles. I will adopt it as a sufficient generalization for present purposes, but in future work a more fundamental theoretical grounding for it should be sought.[12]

At any rate, $\Uparrow P(x)$ immediately entails $\Uparrow Q(x)$ if $P(x)$ immediately entails $Q(x)$. Hence, immediate entailment relations are retained between the SEMs of two VoicePs and the corresponding affirmative finite TPs. However, this does not cover the negative arrow operator $\Downarrow$. The T-concept $\Downarrow P(x)$ applies to everything if $P(x)$ applies to nothing; i.e. if $\neg\exists x P(x)$. Here, immediate entailment between $P(x)$ and $Q(x)$ does not guarantee immediate entailment between $\Downarrow P(x)$ and $\Downarrow Q(x)$. To account for translation between negated clauses, I suggest using the principle (78) introduced in Section 5.2 for immediate entailment in a discourse.

[12]The problem bears resemblance to much-discussed worries within truth-conditional semantics in the Davidsonian framework (Davidson 1967b). If *S is true iff p* provides the truth-condition *p* for sentence *S*, then so does *S is true iff p and 1+1=2*, and any other combination of *p* with a necessary truth. For throrough discussion of the Davidsonian program and its challenges, see Lepore and Ludwig (2005, 2007).

Suppose $P(x)$ and $Q(x)$ are the respective SEMs of the source and target VoiceP. If $P(x)$ and $Q(x)$ are equivalent, then so are $\Downarrow P(x)$ and $\Downarrow Q(x)$. Hence, equivalence guarantees immediate entailment between their respective negative T-concepts as well. Trivially, this also covers the case where $P = Q$. On the other hand, if $P(x)$ immediately entails $Q(x)$ but is not equivalent with it, then $\Downarrow P(x)$ no longer necessarily immediately entails $\Downarrow Q(x)$. Consider, for instance, translating the German negated sentence *Mary ist nicht meine Lehrerin* to the English target *Mary is not my teacher*. Even though the affirmed variant of the source (*Mary ist meine Lehrerin*) immediately entails the affirmed variant of the target (*Mary is my teacher*), adding negations to both removes immediate entailment: the source could be true even if the target was not – e.g. if Mary was a man.

A similar issue was discussed above for *divergent translation*, resulting in principle (78). This states that A immediately entails B in discourse **D** if A together with some X $\in$ **D** immediately entails B (in the target domain). For example, if the person in question is specified to be a woman in **D**, then *teacher* immediately entails *Lehrerin*. The same principle can be extended to negative T-concepts as well: such discourse information also allows securing immediate entailment between the negated clauses *Mary ist nicht meine Lehrerin* and *Mary is not my teacher*, when translating from German to English.

Conversely, when the source VoiceP is translated to a target that requires additional discourse information (as in divergent translation), this secures entailment between their respective negations. The English source *Mary is my teacher* would translate to the German *Mary ist meine Lehrerin*, which is more informative than the source because gender information is added. That is, *Lehrerin* specifies an extension of entities that is a proper subset of the extension specified by *teacher*. Consequently, the negated source *Mary is not my teacher* entails the negated target *Mary ist nicht meine Lehrerin*. Since every *Lehrerin* is a *teacher*, then everything that fails to be a *teacher* also fails to be a *Lehrerin*. As discussed above, entailment assimilates to immediate entailment in T-concepts. Therefore, if additional discourse information is needed for maintaining immediate entailment between $P(x)$ and $Q(x)$, this in turn secures immediate entailment between $\Downarrow P(x)$ and $\Downarrow Q(x)$.

To summarize the discussion on T-concepts, immediate entailment between $\Uparrow P$ and $\Uparrow Q$ is secured by immediate entailment between P and Q; and immediate entailment between $\Downarrow P$ and $\Downarrow Q$ functions on the same basis as immediate entailment in a discourse. Hence, while T-concepts introduce certain complications, they can be incorporated without revoking the analysis of translation as immediate entailment. It would of course require much further work to investigate whether this can be expanded to cover all Domain 2 SEMs across languages. While establishing this is beyond my current capacities, I believe the hypothesis deserves to be taken seriously as a guide for further research on translation.

In Domain 3, the Force feature at C seems to resist an entailment-based analysis since its SEM is not a concept but rather an instruction for a certain speech act type. However, there is an important sense in which declaratives (corresponding to assertion), interrogatives (corresponding to inquiry), and imperatives (corresponding to commands) all respect entailment relations. If I assert something, then I am also asserting what it entails; if I ask something, I am also asking if what it entails holds; and if I issue a command, I also require whatever it entails. Hence, immediate entailment relations are preserved when a T-concept is taken as the argument of a Force operator. I leave the further examination of Domain 3 for future work.

5.2.4 Summary: translation as inter-lingual immediate entailment

Section 5.2.1 argued that translation should be thought of as *inference*, and Sections 5.2.2–5.2.3 outlined the analysis of translation as *immediate entailment* between source and target SEMs. Crucially, inference requires no constitutive overlap between the source and target SEMs, which differentiates my account from the prevalent conception of translation as expressing the *same* conceptual content in different languages.

Translation involves finding a target that is immediately entailed by the source in the target domain, possibly appended with discourse information. Immediate entailment maximizes *informativity* among entailed target concepts. The use of superfluous discourse information is avoided in accordance with the principle of *conserativity*.

The immediate entailment account is applicable to both atomic and complex concepts; but certain important properties set *compositional translation* apart from the translation of either syntactic heads or idiomatic phrases. In particular, if A_1 immediately entails B_1 and A_2 immediately entails B_2, then $A_1 \wedge A_2$ immediately entails $B_1 \wedge B_2$ *unless* the target domain contains some other concept X, where (i) $A_1 \wedge A_2 \Rightarrow X$, (ii) $X \Rightarrow B_1 \wedge B_2$, and (iii) $B_1 \wedge B_2 \not\Rightarrow X$. This information about X would need to be explicitly memorized, as it does not follow from the immediate entailment between the pairs $A_1 - B_1$ and $A_2 - B_2$ alone.[13] Therefore, in the absence of

[13]Strictly speaking, it needs to be *based on* some additional explicitly memorized information. It could be inferred from memorized information without itself being explicitly memorized as such.

such additional information, $B_1 \wedge B_2$ constitutes the default immediate entailment of $A_1 \wedge A_2$. It thus resembles *elswehere cases* in Vocabulary Insertion, which are used when more specific contextual specifications do not apply. This default status of conjunction explains the productivity of compositional translation in the syntactic Domain 1, in a similar way as how elsewhere cases account for the productive use of regular morphology.

With respect to the syntactic Domain 2, I discussed the arrow operators used by Pietroski (2018) for creating Tarskian T-concepts. The affirmative variant ($\Uparrow$) retains immediate entailment relations: if $P(x)$ immediately entails $Q(x)$, then $\Uparrow P(x)$ immediately entails $\Uparrow Q(x)$. For the negative variant ($\Downarrow$), immediate entailment relations are not always retained. However, such cases can be resolved with independently motivated principles needed for immediate entailment relativized to a discourse. Hence, while the arrow operators result in certain challenges, they can be incorporated into the present framework without altering the basic theory. Further discussion on Domain 2–3 heads is allocated to future work.

5.3 Explaining translation universals

So far, this chapter has concentrated on the theoretical question concerning the nature of translation as a conceptual relation between source and target SEMs. In this section, I apply the framework for explaining prior empirical findings concerning *translation universals*, which are properties specific to translated texts across many languages. In particular, I focus on the following translation universals, corroborated across multiple studies and languages (for general overviews, see Baker 1993, Laviosa-Braithwaite 2001, Malmkjaer 2011):

1. preference for word-to-word translation (Section 5.3.1)
2. explication (Section 5.3.2)
3. simplification (Section 5.3.3)
4. overrepresentation of source language -typical grammar (Section 5.3.4)

5.3.1 Preference for word-to-word translation

Word-to-word translation has been argued to be preferred over *unit shifts*, where a single word is translated to multiple words or vice versa (Catford 1965: 79; see also Chapter 6, Section 6.3). Reiss (1971) noted the problem of "missing words", where translations fail to make full use of the lexical resources of the target language. Shlesinger (1992) found that both student and professional translators failed to lexicalize multi-word source expressions even if the target language contained a possible single-word translation. Toury's (1995) "law of interference" predicts that source expression constituents tend to be transferred directly to the target without larger structural changes. Hönig (1988: 158, 1995: 25) proposes "translate word-for-word when possible" as an implicit rule among novice translators (Kujamäki 2004: 199).

The hypothesis has received additional support from English-Finnish translation. Tirkkonen-Condit (2004) studied the frequency of *unique items* in Finnish – i.e. words that lack a direct translation in most other languages. She focused on *sufficiency verbs*, such as *jaksaa* ('be strong enough' or 'have enough energy'), *ehtiä* ('have enough time'), or *mahtua* ('be small enough'). In many other languages (including English), corresponding meanings are expressed by complex phrases. This motivates the hypothesis that they should be underused in translated Finnish, as the source expression is likely to lack their direct lexical correlates (Tirkkonen-Condit 2002, Chesterman 2017: 270).

The prediction was borne out in Tirkkonen-Condit's (2004) comparative results on translated and non-translated Finnish, for both fiction and academic text. Even though some sufficiency verbs were not rarer in translated text (*viitsii* in either fiction or academic text; *viithyy* or *rohkenee* in academic text), the vast majority of them were. She further replicated these findings for *clitic particles* such as *-hAn* or *-kin*, which lack direct grammatical correlates in most languages. Her results are shown in Table 5.1. Kujamäki (2004) also found similar translation effects for Finnish-specific weather terms, such as *kinos* ('snowdrift/snowbank') or *keli* ('road/snow/surface conditions' or 'weather').

In the present framework, word-to-word translation indicates *compositional translation*. For a conjunctive source SEM, finding the target by conjoining SEMs immediately entailed by the source's conjuncts provides the *default* case, which secures immediate entailment in contexts that lack more specific contextual information. This follows from principle (83) in Section 5.2.2. Its empirically evaluable consequence is that conjunctive targets are expected for conjunctive sources, if they are available. Non-conjunctive targets can be used as well, but they are not expected to have a correspondingly prevalent status as conjunctive targets.

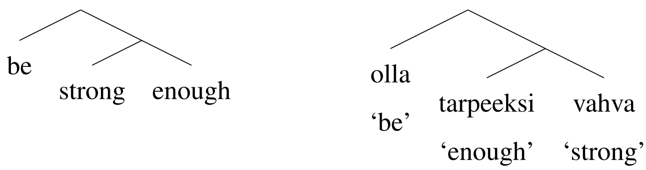
As an example, consider translating the English source expression *be strong enough* to Finnish. While this is roughly equivalent with the sufficiency verb *jaksaa*, the frequency of this verb is lower in translated Finnish than in non-translated Finnish (Tirkkonen-Condit 2004; Table 5.1, row 2). While Tirkkonen-Condit's data does not show how the English expression

Unique item	English translation	Frequency (per 1000 words)			
		Fiction		Academic	
		Original	Translated	Original	Translated
ehtii	'has enough time'	0.499	0.324	0.094	0.026
jaksaa	'is strong enough' / 'has enough energy'	0.277	0.132	0.023	0.017
riittää	'is enough'	0.265	0.246	0.202	0.143
uskaltaa	'has enough courage' / 'has the nerve to'	0.234	0.097	0.021	0.029
kelpaa	'is good enough'	0.096	0.045	0.032	0.004
mahtuu	'is small enough'	0.087	0.038	0.017	0.008
viitsii	'has enough initiative or interest'	0.080	0.096	0.004	0.005
kehtaa	'is bold enough'	0.069	0.012	0.009	0.001
viihtyy	'is comfortable enough'	0.064	0.039	0.004	0.008
malttaa	'is patient enough'	0.050	0.020	0.004	0.002
rohkenee	'is brave enough'	0.037	0.009	0.005	0.007
joutaa	'is idle enough'	0.020	0.007	0.001	0.000
-kin	(varies)	6.942	5.063	7.258	5.873
-hAn	(varies)	1.954	1.280	0.668	0.264

Table 5.1: Frequencies of unique items in translated and non-translated Finnish (from Tirkkonen-Condit 2004: 180–181).

is translated, a prominent candidate would be *olla tarpeeksi vahva*, which is a compositional translation of *be strong enough*. The simplified source and target phrases are shown in (85):

(85)



In (85), equivalence (or at least approximate equivalence in most contexts) manifests between the pairs *be*–*olla*, *strong*–*vahva*, and *enough*–*tarpeeksi*. The word-order difference between the adverb and adjective (*strong enough* vs. *tarpeeksi vahva*) has no SEM-relevance, so the full SOs can also be considered equivalent for present purposes. Therefore, *olla tarpeeksi vahva* is a compositional translation of *be strong enough*. A non-compositional translation (such as *jaksaa*) is thus only expected to occur if it has some *additional* motivation. This could happen for many possible reasons: perhaps *jaksaa* has a high level of background activation because it was used recently and is salient in the speaker's memory; perhaps it is primed by some other word; etc. Nevertheless, while such motives for using non-compositional translation are possible, the compositional variant still retains its *default* status.

Notably, this account of compositional translation does not allocate the seeming "word-to-word" preference to mappings between syntactic structures as such. Instead, it maintains that the translation relation obtains only between SEMs. The commonality of word-to-word translation arises indirectly from the typical mapping between "words" (i.e. categorized roots in DM) and atomic SEMs, and from the conjunctive SEMs of complex phrases.

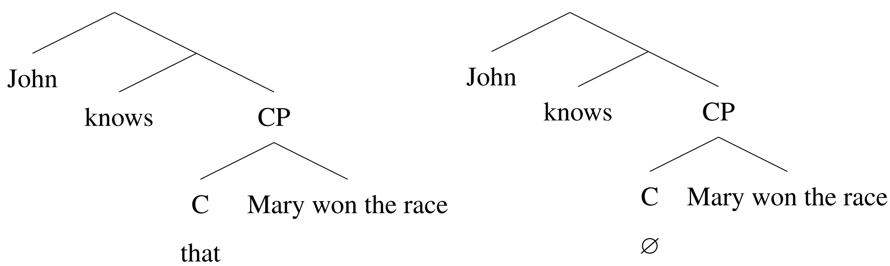
5.3.2 Explication

Another proposed translation universal initially seems to go to the opposite direction from word-to-word preference. Summarizing the results of Vanderauwera (1985) on Dutch-English translation, Laviosa-Braithwaite (2001) lists the following means by which *explicitness* can be increased in the target text:

> "The main procedures she [Vanderauwera (1985)] records are the use of interjections to express more clearly the progression of the characters' thoughts or to accentuate a given interpretation, expansion of condensed passages, addition of modifiers, qualifiers and conjunctions to achieve greater transparency, addition of extra information, insertion of explanations, repetition of previously mentioned details for the purpose of clarity, precise renderings of implicit or vague data, the provision of more accurate descriptions, the explicit naming of geographical locations and the disambiguation of pronouns with precise forms of identification."
> (Laviosa-Braithwaite 2001: 289)

Two observations are especially worth emphasizing. First, many cases of explication involve *grammatical* and not lexical material; and some such cases are furthermore plausibly allocated to *PF* rather than Narrow Syntax. For example, Olohan and Baker (2000) report an higher frequency of the complementizer *that* in translated English than in non-translated English. Embedded clauses arguably contain the functional head C irrespective of whether it is phonologically overt. This is shown by the simplified illustration (86), where the left-hand side has the overt C and the right-hand side has the covert C:

(86)



Hence, at least some cases of explication plausibly concern PF-level phenomena instead of SEMs. Here, preference for compositional translation makes no particular predictions concerning alternative targets, since the differences are invisible to SEMs. In such cases, explication could arise due to the pragmatic goal of ensuring clarity in communication: if there are different ways to express the same SEM, using the most clearly interpretable alternative is *prima facie* preferred. Clarity can often be increased by expressing elements overtly, such as using *that* instead of a covert complementizer.

On the other hand, some types of explication add lexical content, such as the insertion of further material for explaining the target more clearly. Here, I suggest that *conjunctive closure* can be relevant, as specified by the principle (76) in Section 5.2.2. This principle states that if the source A immediately entails both B and C in the target domain, then it will immediately entail the conjunction B $\wedge$ C if this is added to the target domain. This is because B $\wedge$ C is always equally or more informative than B or C alone. Consequently, one way to increase the informativity of the target is to expand the target domain by adding the conjunction of multiple immediately entailed concepts.

The same principle can be expanded for intra-lingual paraphrasing as well. As a toy example, consider paraphrasing the English noun *sock* without using the word itself. Socks are clothes, and also something you wear on your feet. Hence, in the English target domain where the concept itself is unavailable, SOCK immediately entails both CLOTHING and WORN-ON-FEET (the latter being a placeholder for a more complex concept). However, this target domain can be extended by introducing their conjunction CLOTHING $\wedge$ WORN-ON-FEET. This conjunctive concept is more informative than either conjunct alone, and hence *clothing worn on your feet* is a more appropriate paraphrase of *sock* than either *clothing* or *something worn on your feet* alone.

Explication in translation is a multifaceted phenomenon, and I make no claim of any conclusive or all-encompassing analysis of it here. It may involve many distinct processes that do not converge to a single unified basis. Still, the brief discussion above makes note of predictions motivated by the present theoretical framework, which align well with certain findings on explication. First, even though compositional translation favors $1 - 1$ mappings between the constituents of conjunctive source and target SEMs, it makes no predictions on the phonological expression of grammatical material; and here pragmatic considerations of clarity can explain the preference for phonological overtness. Second, the addition of lexical material can, at least in certain cases, be motivated by the principle of conjunctive closure, where immediate entailment relations are made more informative by appending the target domain with conjunctions of immediately entailed concepts.

5.3.3 Simplification

Translated texts have been proposed to be both grammatically and lexically simpler than their source texts (Baker 1993, Laviosa 2002, Kajzer-Wietrzny et al. 2016). Syntactic simplification can involve e.g. splitting up long sentences or replacing infinite constructions with finite ones (Vanderauwera 1985, Puurtinen 2003, Grabowski 2013). *Avoiding repetition* in the target text has also been observed as a reliable tendency (Shlesinger 1991, Toury 1991, Baker 1993).

Blum and Levenston (1978) propose that lexical simplification is universally manifested in various circumstances, including but not limited to translation.[14] They divide its manifestations to two variants: *over-generalization* and *transfer*. Over-generalization can involve the use of superordinate terms, approximation, familiar synonyms, circumlocutions, or paraphrases. Transfer is a process where the target word is assigned all the semantic and/or pragmatic functions of the source word even if these are not its typical properties in the target language.

Like explication, simplification is a multifaceted process that does not easily lend itself to a unified all-encompassing explanation. That being said, I provide brief accounts of how the observations mentioned above could be accommodated within the present framework. Importantly, no additional theoretical assumptions are needed for making the relevant predictions.

In terms of syntax, free choice between SEM-equivalent constructions is allowed for translation, and the choice between these is made based on other considerations than SEMs alone. This can account for cases where syntactic simplification removes no relevant information from the target SEM, such as sentence splitting or changing verb finiteness. The same principle also applies across equivalent SEMs, as in synonyms or paraphrases. As with explication, the reason why one candidate is preferred to another can be explained via general considerations of communicative efficiency, which are not specific to translation alone.

Avoiding repetition can be accounted for by the principle of *conservativity*, manifested as the shunning of superfluous conjunctive information. Consider principle (79) from Section 5.2.2, repeated below as (87):

(87) **Avoid superfluous discourse information:**
If A immediately entails both B_1 and $B_1 \wedge B_2$ in domain δ given discourse $\mathbf{D}$, choose B_1 over $B_1 \wedge B_2$.

[14]Beyond translation, simplification can take place e.g. during second language acquisition or when native speakers address non-native speakers. Blum and Levenston (1978) further distinguish between situation-bound simplification and general processes that repeat across situations. Here, I only consider the latter.

Since repeated information is *ipso facto* already present in the prior structure, it exemplifies the superfluous B_2 in (79)/(87). Hence, this principle facilitates its removal from the target.

Of the lexical simplification strategies identified by Blum and Levenston (1978), overgeneralization can be analyzed as *restricting the target domain* of immediate entailment. Immediate entailment relations are relativized to the target domain, which is a set of possible candidate concepts (see Section 5.2.2). For contextually varying reasons (accounting for which lies beyond the present framework), the speaker will consider some concepts as potential targets while discarding others. Restricting the target domain can lead to *less specific* target SEMs, and thereby the use of superordinates or approximation.

Transfer, in contrast, involves the modification of the normal target SEM, which can be considered a variant of *polysemy* (see Chapter 4, Section 4.3.1). This could be analyzed in different ways. One possibility is that the source SEM is copied directly, expanding the range of possible SEMs of the target word. Another possibility is that a novel *ad hoc concept* is coined as the target SEM (Carston 2002, 2019, Wilson and Carston 2007). I leave further details of the analysis of transfer open; what is important for present purposes is that its possibility follows from the more general phenomenon of polysemy, which extends beyond translation.

In sum, both explication and simplification can occur because the choice between SEM-equivalent expressions is motivated by pragmatic factors such as the aim to maximize the target's ease of reading (Pym 2008). In lexical content, explication and simplification can be seen as manifestations of principles (76) and (79), introduced in Section 5.2.2. Explication arises from the expansion of the target domain with conjunctive SEMs, while simplification arises from the shunning of unnecessary conjunctive information.

5.3.4 Overrepresentation of source language -typical grammar

Grammatical constructions that are typical of the source language tend to occur more in translated than non-translated text (Toury 1995, Tirkkonen-Condit 2004, Mauranen 2004, Eskola 2004). Importantly, this has been observed even for grammatical patterns not present in the source expression itself. For instance, Mankkinen (1999) found that Finnish anglicisms (e.g. *ottaa aikansa* for the English *take its time*) appear more in translated Finnish even when they do not grammatically correspond to the English source expression (Mauranen 2004: 68). Therefore, the effect is not reducible to word-to-word preference (as covered in Section 5.3.1).

Eskola (2004) studied the translation of three Finnish non-finite verb forms. First, *referative* constructions correspond semantically to affirmed *that*-clauses, but have no direct grammatical equivalent in English. While Finnish allows free variation between the non-finite referative form and its finite counterpart, English tends to favor the finite or non-finite form depending on the main verb hosting the embedded clause. As shown in (88)–(89), English uses non-finite embedded clauses with *see* and finite embedded clauses with *know*, while Finnish allows both finite embedded clauses and their non-finite referative counterparts irrespective of the main verb (examples modified from Eskola 2004: 89):

(88) a. Näin Liisan **lukevan** kirjaa
see.1SG.PAST Liisa.GEN read.INF.PRES book.PART
(non-finite referative construction)

b. Näin, että Liisa **lukee** kirjaa
see.1SG.PAST that Liisa read.3SG.PRES book.PART
(finite)

c. I saw Liisa **read/reading** a book

(non-finite)

(89) a. Tiedän hänen **tulleen**
know.1SG.PRES 3SG.GEN come.INF.PAST
(non-finite referative)

b. Tiedän, että hän **on** **tullut**
know.1SG.PRES that 3SG have.3SG.PRES come.INF.PAST
(finite)

c. I know (that) (s)he **has come**

(finite)

Second, *temporal* constructions are used to relate the embedded clause temporally to the main clause. As exemplified by (90)–(91) (modified from Eskola 2004: 92), English often allows both finite and infinite translations of Finnish temporal constrictions:

(90) a. **Lukiessaan** kirjaa...
read.INF.PROG book.PART
(non-finite temporal construction)

b. Kun hän **lukee** kirjaa...
when 3SG read.3SG.PRES book.PART
(finite)

c. **Reading** a book...

(non-finite)

d. As she **is reading** a book...

(finite)

(91) a. **Luettuaan** kirjan...
read.INF.PERF book.GEN
(non-finite temporal construction)

b. Kun hän **on** **lukenut** kirjan...
when 3SG have.3SG.PRES read.INF.PAST book.GEN
(finite)

c. **Having read** the book...

(non-finite)

d. When she **has read** the book...

(finite)

Third, the *final construction* expresses the embedded clause as stating the purpose of the main clause. It has a straight-forward non-finite translation in English, shown in (92) (modified from Eskola 2004: 95):

(92) a. Kiirehdin **ehtiäkseni** junaan
hurry.1SG.PAST have-time.1SG.INF train.ILL
(non-finite final construction)

b. Kiirehdin, jotta **ehtisin** junaan
hurry.1SG.PAST in-order have-time.1SG.COND train.ILL
(finite)

c. I hurried (in order) **to catch** the train

(non-finite)

Eskola's (2004) results show discrepancies between the frequencies of the three constructions in non-translated and translated Finnish, with English and Russian as source languages. In particular, translated Finnish manifests *fewer referative constructions* and *more final constructions* than non-translated Finnish. More generally, the frequencies of the three constructions in translated Finnish depend on the availability of their grammatical correlates in the source languages. Referative constructions are quite common in non-translated Finnish, but are clearly reduced in translated Finnish due to the lack of a straight-forward grammatical correlate in either English or Russian. Final constructions are rare in non-translated Finnish, but their frequency more than doubles due to the availability of clear source language correlates.

Corpus	Size (words)	Number and frequency of constructions		
		Referative	Temporal	Final
Non-translated	619296	2604 (0.42%)	1107 (0.18%)	232 (0.04%)
Translated from English	639608	1869 (0.29%)	1830 (0.29%)	628 (0.10%)
Translated from Russian	635511	851 (0.13%)	1849 (0.29%)	564 (0.09%)

Table 5.2: Referative, temporal, and final constructions in translated and non-translated Finnish (derived from Eskola 2004).

The frequency of the temporal construction also increases by more than one third in translated Finnish. The results are provided in Table 5.2.

Eskola also observes a similar effect on word-order. Finnish temporal constructions allow a free choice in verb-object order, as in *autoa pestessään* or *pestessään autoa* ('while washing her/his car'). In non-translated Finnish, the pre-verbal position is used in 55% of temporal constructions, but this number drops to $23.0\% - 25.6\%$ in translated Finnish. Eskola attributes this to the verb-final position of objects in both Russian gerunds and English *-ing*-forms.[15]

In summary, translated texts tend to manifest grammatical patterns typical of the source language when these are available in the target language. Mauranen (2004) proposes that this effect takes place not at the level of the source and target expression themselves, but rather indirectly via the *simultaneous activation* of the source and target languages (p. 68). She considers such influence to be a straight-forward consequence of language contact within bilingual cognition, citing Cook's (2003) notion of "multicompetence". Despite the differences between the overall theoretical frameworks used by me and Mauranen, there are important similarities between her account of source language influence on translation and the analysis of bilingualism developed in Chapter 3 (Section 3.3).

In my theoretical framework, "languages" within a bilingual I-language are maximal groups of positively connected PF-rules. Incorporating the main idea in Mauranen's analysis, I assume that translation involves co-activating both the source and target language – i.e. both groups of PF-rules. The source language is activated when processing the source expression, and the target language when producing the target expression. In actual translation performance, these tasks are plausibly switched dynamically, which is expected to lead to the simultaneous activation of both languages. PF-rules that are *shared* by both languages are thus expected to be activated the most, since their activation is facilitated by both.

[15]Eskola also observes some variation based on the source language, with e.g. Finnish translated from English manifesting more present tense temporal constructions, and Finnish translated from Russian manifesting more past tense temporal constructions. However, the basis of these findings is unclear (Eskola 2004: 94).

Furthermore, I propose that PF-rules associatively *prime* the syntactic objects they apply to, and the resulting overall activation pattern can be assimilated to a "language mode" (see Chapter 3, Section 3.3.5). The simultaneous processing of two languages – as manifested in translation – is thus expected to result in the strongest activation of lexical and/or grammatical elements that are targeted by PF-rules shared by both languages. By the same token, those elements that are only present in the target language but not the source language are not primed by the source language, and hence are expected to be less common in translations.

Applying the hypothesis to Eskola's (2004) data, final constructions are syntactically available in both Finnish and English, whereas referative constructions are only available in Finnish. In translation, two groups of PF-rules are co-activated: one for the source language (English) and one for the target language (Finnish). Since both groups contain rules that allow pronouncing the final construction, its syntactic elements are primed to an exceptionally high degree. Hence, Finnish final constructions are readily available as target candidates for English final constructions. In contrast, since English lacks the referative construction, the corresponding syntactic elements only have a low background activation in Finnish as the target language. This results in their less likely consideration as Finnish target candidates.

5.3.5 Summary: observed translation universals are expected

Sections 5.3.1–5.3.4 have covered four types of translation universals recognized in prior literature, and illustrated how the present theoretical framework *predicts* each of them. The prevalence of word-to-word translation arises from the default status of compositional translation for syntactically complex source expressions. Explication involves the addition of information to the target domain, following the principle of *conjunctive closure*. Simplification arises due to the shunning of superfluous information in the target that can be removed without sacrificing immediate entailment (in the discourse). Both explication and simplification can also arise when the choice between multiple SEM-equivalent target candidates needs to be made based on pragmatic grounds involving generic communicative maxims. Finally, given the analysis of bilingualism presented in Chapter 3 (Sections 3.3.3–3.3.5), target candidates that share syntactic structure with possible source language constructions are expected to have higher levels of activation, due to their availability for PF-rules in both the source and target language. Therefore, source language -typical grammatical patterns are expected to appear in the target, even when these do not correspond directly to the source.

5.4 Summary

In this chapter, I have proposed that translation should be analyzed as a variant of *inter-lingual inference* instead of conceptual overlap. Specifically, I proposed that translation amounts to *immediate entailment* between the source and target SEMs in the target language domain, given the background discourse. These relations between SEMs can be maintained in the absence of their constitutive overlap. This allows a modest type of linguistic relativity: the source and target language can use different concepts in their respective SEMs. Crucially, however, this does not abandon their *commensurability* in conceptual cognition.

Immediate entailment secures an optimum between *informativity* and *conservativity*: it maintains as much information of the source as possible without introducing novel information. To account for cases where the target is more informative than the source, I further proposed a discourse-bound variant of immediate entailment, where the source immediately entails the target given some discourse information. Superfluous discourse information that can be removed while retaining immediate entailment is still avoided.

If A_1 immediately entails B_1 and A_2 immediately entails B_2, then $A_1 \wedge A_2$ immediately entails $B_1 \wedge B_2$ *by default* – i.e. in the absence of additional information that specifies otherwise. Such *compositional translation* can explain the *productivity* of translation across complex expressions in the syntactic Domain 1, in a manner analogous with *elsewhere rules* in Vocabulary Insertion (Chapter 3, Section 3.1.8). Furthermore, even though higher-domain SEMs can be non-conjunctive, compositional translation (in a discourse) can also ground immediate entailment between Tarskian T-concepts (Pietroski 2005a, 2018).

While the main content of this chapter has been rather abstract, I also illustrated the explanatory relevance of the framework in accounting for translation universals observed in prior empirical literature. While more work is needed to assess the empirical validity of proposed translation universals across different languages and translation contexts (see e.g. Jia et al. 2022), each of the universals discussed in Section 5.3 can be predicted on independent grounds.

Chapter 6

Analyzing Finnish-English translation

With the theoretial framework in place, this chapter analyzes concrete translation examples between Finnish and English. The examples are taken from a *parallel corpus* consisting of human-made translations. Typically, parallel corpora are used for training machine translation systems. They have also been used in contrastive linguistics, which aims to uncover differences and similarities in the marking of corresponding grammatical constructions between different languages (Ebeling 1998, Johansson 2003, Barkow 2008, Doval and Nieto (ed.) 2019). However, to my knowledge, this chapter constitutes the first large-scale application of parallel corpora to theory-driven linguistic analysis from a generative perspective.

Continuing the methodological discussion in Chapter 2 (Section 2.2.3), I expand on the idea that parallel corpora can be considered as repositories of *linguistic judgements*. While such repositories are rarely available for other types of judgements (concerning e.g. grammaticality),[1] parallel corpora allow combining the judgement-based methodology of standard generative linguistics with corpus analysis. However, in contrast to data-driven studies, my aim is not merely to describe the corpus or find its salient statistical features, but instead to use it as empirical evidence for evaluating the theoretical hypotheses formulated in prior chapters.

Section 6.1 gives brief overviews of Finnish and English grammar. Section 6.2 covers the methodology used for obtaining the parallel data, and analyzing it with a combination of automatic and manual techniques. Section 6.3 presents the results for Finnish-English *unit shifts* (in both directions), where a single source word is translated to multiple target words. Section

[1] The largest corpus of grammaticality judgements is the *Corpus of Linguistic Acceptability (CoLA)*, presented in Warstadt et al. (2019) (`https://nyu-mll.github.io/CoLA/`). Since it is derived from examples in linguistic literature, it does not constitute a genuine counter-example to the case made here.

6.4 covers *word-order shifts*, where A_1 translates to B_1 and A_2 translates to B_2, but the word-order is $A_1 > A_2$ in Finnish and $B_2 > B_1$ in English. Section 6.5 identifies the syntactic basis for the most translation shifts covered in Sections 6.3–6.4, and Section 6.6 discusses lexically motivated translation shifts. Finally, Section 6.7 provides a pipeline for predicting syntactic properties in Finnish-English translation (in both directions), relying on the theoretical framework presented in Chapters 3–5 and incorporating the observed translation shifts.

6.1 Overview of Finnish and English grammar

Finnish is a Finno-Ugric language in the Uralic family, with an unmarked subject-verb-object (SVO) word-order and a rich agglutivative morphology. Verbs inflect in tense (present/future, past, perfect, pluperfect) and mood (indicative, imperative, conditional, potentional). Active verbs agree with the subject in person and number, while passive verbs exhibit no agreement.[2] First and second person pronouns allow *pro-drop* when appearing as subjects of active verbs or as possessors of noun phrases. Nouns inflect in number and case, with concord by numeral and adjective modifiers. Nouns have no mandatory (overt) determiners. *Yes/no* questions are formed via verb movement and the addition of a question particle (*-ko*) to the verb. Imperatives involve verb movement as well. *Wh*-questions are formed via *wh*-movement to the left edge of the clause. The question particle (*-ko*) can also be used to form non-*wh*-question phrases. Clausal word-order can be altered quite freely, but this has systematic impacts on interpretation with respect to e.g. topicalization and focus.

English is a Germanic language in the Indo-European family, with light agglutivative morphology (modified by some irregular inflection) and a mostly strict SVO word-order. Verbs inflect in tense (present, past, perfect, pluperfect)[3] and aspect (perfective, imperfective/progressive). Both active and passive verbs agree with the grammatical subject in person and number. Nouns inflect in number and take mandatory determiners. Overt case is limited to pronouns (assuming that the possessive *'s* is a clitic and not a genitive case marker). All adpositions are prepositions. All questions and imperatives involve verb movement, and *wh*-phrases are moved to the left edge of the clause.

[2]It has been questioned whether Finnish has a genuine passive due to the lack of agreement and the grammatical subject position (Spec,TP) allowing other elements than a promoted direct object (Shore 1988). For a critique and an analysis of Finnish as manifesting a genuine passive, see Manninen and Nelson (2004).

[3]English also expresses future tense, but via an auxiliary rather than verb inflection.

Overviews of Finnish syntax are provided by e.g. Hakulinen and Karlsson (1979), Vilkuna (1989), Vainikka (1989), Vilkuna (1996), Hakulinen et al. (2004), Brattico (2008a), Karlsson and Chesterman (2008), and Karlsson (2009). Tamm and Vainikka (2018) survey generative research on Finnish.[4] The numerous general works on English syntax include Quirk et al. (1985), Baker (1995), Aarts (2011), and Burton-Roberts (2022). Much of the theoretical development of generative linguistics has been based around the analysis of English, which is reflected in standard textbooks (e.g. Radford 1988, 2004, 2009, Haegemann 1994, Adger 2003, Carnie 2013).

6.2 Methodology

This section focuses on experimental methodology from both a theoretical and practical perspective. Section 6.2.1 discusses the basis of using parallel corpora for evaluating translation hypotheses. The basic idea is that parallel corpora can be considered as repositories of *judgements*. Section 6.2.2 describes the concrete methodology to be used for data analysis in Sections 6.3–6.4, which combines automatic and manual techniques.

6.2.1 Parallel corpora as repositories of translation judgements

As covered in Chapter 2 (Section 2.2.3), theoretical linguistics (especially in the generative framework) predominantly relies on *judgements* as data. Assuming that the goal of linguistic theory is to understand I-language, judgements can be treated as outcomes of I-language processing a linguistic datapoint (together with the rest of cognition). Hence, if a hypothesis predicts that an I-language of the relevant kind should treat certain expressions as (un)grammatical/equivalent/(in)compatible/(...), it can be tested by checking whether elicited judgements are in line with the predictions.[5] While there is no reliable introspective access to I-language (or the conceptual system) as such, judgements provide central indirect evidence for or against competing hypotheses.

[4] Additional generative studies on Finnish not cited by Tamm and Vainikka (2018) include Dal Pozzo (2007), Gröndahl (2014) and Saikkonen (2018).

[5] As a variant of abductive reasoning, hypothesis-testing based on linguistic judgements can never fully secure any hypothesis. It can only provide evidence for or against a hypothesis, to be considered in light of background assumptions, other results, general considerations of theoretical parsimony, etc. The same considerations apply across all empirical sciences, and are not specific to linguistics.

Judgements have been criticized for unreliability, and the use of more quantifiable techniques has been recommended (Schütze 1996, Edelman and Christiansen 2003, Wasow and Arnold 2005, Gibson et al. 2013, Juzek and Häussler 2020). Nevertheless, the problem in discarding judgements is that, outside of them, evidence is often not available for evaluating hypotheses about I-language. Theoretical linguistics is not committed to relying on judgements as such, but in practice they often remain the only available source for crucial information needed to develop analyses further.

Simple corpora contain unlabeled language data, without any information on judgements. Based on this alone, only statistical information about the prevalence of some patterns over others can be obtained. This does not reveal whether speakers would judge less prevalent patterns as ungrammatical, incoherent, etc. Therefore, simple corpora alone cannot replace judgements as means to evaluate linguistic hypotheses.

In contrast, due to the significant increase of data-driven machine learning in recent years, *human-labeled* corpora have become increasingly available. Here, the corpus itself can be considered as a repository of certain types of judgements made by the people responsible for the labeling. As an illustrative example, the *Stanford Natural Language Inference* corpus (SNLI) consists of sentence pairs manually labeled as 'entailment', 'neutral', or 'contradiction' based on semantic relations between the two sentences (Bowman et al. 2015). Hence, if some sentence pair S_1–S_2 is labeled as e.g. 'entailment' in SNLI, this constitutes evidence that the person(s) responsible for adding this datapoint judged S_1 to entail S_2.

Furthermore, some corpora map linguistic source expressions to target expressions instead of mere classificatory labels. The most prevalent variants of such *parallel corpora* contain translation pairs, and I only consider these here. A datapoint in a parallel corpus can thus be treated as a *translation judgement* of the generic form (93), where S_1 and S_2 are expressions, and L is the target language:

(93) S_1 translates to S_2 in L

Counting instances of (93) as linguistic judgements might at first seem to extend the notion of "judgement" too much, since translating S_1 to S_2 markedly differs from providing a "yes/no" answer as a grammaticality judgement. However, this is only a superficial difference, as (93) can be trivially modified into a binary judgement concerning whether the pair $<S_1, S_2>$ satisfies the translation relation (for the target language L). This is similar to judgements about entailment relations between sentence pairs, as recorded in e.g. the SNLI corpus. In fact, if the account of translation proposed in Chapter 5 is correct, (93) is itself an entailment judgement of the type (94):

(94) SEM(S_1) immediately entails SEM(S_2) in the domain of L

That is, the presence of the source-target pair S_1–S_2 in a parallel corpus can be treated as evidence that the translator(s) responsible for adding the pair to the corpus would consider (94) valid. Given the definition of immediate entailment (Chapter 5, Section 5.2.2),[6] their I-language and conceptual system are structured in ways that satisfy the conditions listed in (95), where **L** is the set of grammatical expressions in L:

(95) a. SEM(S_1) $\Rightarrow$ SEM(S_2)

b. $\neg\exists\Sigma \in \mathbf{L}$ such that:

i. SEM(S_1) $\Rightarrow$ SEM(Σ)

ii. SEM(Σ) $\Rightarrow$ SEM(S_2)

iii. SEM(S_2) $\not\Rightarrow$ SEM(Σ)

The status of the *background discourse* further depends on where the source-target pairs are gathered from. If they are taken from a larger translated text (such as a book), this text provides the relevant discourse information. If, in contrast, the source-target pairs have been produced directly for the parallel corpus, there is no specific background discourse to extract additional information from. However, even then, discourse-bound translation remains possible – such as *teacher–Lehrer/Lehrerin* ('teacher.MASC/FEM'). I assume that in such cases the translator has relied on presuppositions concerning *likely* discourse information, as in (96):

(96) For some large number n: SEM(S_1) immediately entails SEM(S_2) in the domain of L given any $\mathbf{D}_i \in \{\mathbf{D}_1, ..., \mathbf{D}_n\}$.

Even though the discourse is not specified in the parallel corpus itself, (96) contains a "second-order" belief about some background information being likely present in many discourses where the translation S_1–S_2 could be made. Of course, "likely" – or "large" as used in (96) – are themselves highly contextually varied notions. Nevertheless, I maintain that (96) correctly captures the kinds of judgements responsible for the inclusion of source-target pairs into a parallel corpus. Therefore, parallel corpora can be used for the indirect evaluation of

[6] A immediately entails B if A $\Rightarrow$ B and there is no C such that A $\Rightarrow$ C, C $\Rightarrow$ B, and B $\not\Rightarrow$ C.

theoretical hypotheses concerning the cognitive basis of such judgements. This chapter provides empirical results on applying this methodology to a Finnish-English parallel corpus, in both directions.

6.2.2 Pipeline for data analysis

I will now describe the concrete data analysis methodology used for obtaining the results covered in Sections 6.3–6.4. The technique is comprised of the following stages:

1. automatic word-to-word or word-to-phrase alignment of a parallel corpus
2. automatic extraction of translation shifts from the aligned corpus
3. superficial manual labeling of the translation shifts
4. theoretical analysis of the observed patterns

Data. The Finnish-English parallel corpora are taken from *Tatoeba*,[7] which is a large openly available crowd-sourced repository of multilingual translations. The translations have been provided by users specifically for this collection, and mostly represent simple and grammatically correct complete sentences intended to work in both directions (English-Finnish being simply Finnish-English flipped). The Finnish-English corpus contains 95545 sentence pairs, some examples of which are shown in Table 6.1.

Finnish	**English**
katsokaa , mitä teimme .	look at what we made .
hän meni ulos syömään .	he went out to eat .
jääkaapissa ei ollut mitään jäljellä .	nothing remained in the refrigerator .
tom ei osaa puhua juuri lainkaan ranskaa .	tom can hardly speak any french .
jos menet metsään , varo ihmissyöjähirviöitä !	if you go into the forest , watch out for the man-eating ogres !

Table 6.1: Example translations from the Finnish-English Tatoeba corpus.

Alignment. For obtaining word alignments, I used the *GIZA++* software (Och and Ney 2003),[8] which builds on a prior statistical machine translation system (Brown et al. 1993) and Hidden Markov Model -based word alignment (Vogel et al. 1996) using the *Viterbi algorithm* (Viterbi 1967). GIZA++ aligns each source text word to a tuple of target text words.[9] It

[7] `https://tatoeba.org/` (The corpus used for the experiments was obtained in December 2021.)

[8] `https://github.com/moses-smt/giza-pp`

[9] In Tatoeba, "words" correspond to orthographic words, except that contractions (e.g. *n't*) and clitics (e.g. the possessive *'s*) are separated from their hosts. Punctuation markers are also distinct words. A more technical

relies on the assumption that one target word corresponds to at most one source word, while a single source word can have a multi-word target.[10] I ran the alignment in both directions, and gathered all possible targets for each source word along with their counts. Table 6.2 shows example targets and their counts for Finnish and English source words.

Source (Finnish)	Target (English)	Count
menen	i 'm going	41
	i go	28
	i 'll go	26
	go	13
	'm going	12
	i	10
	i 'll	6
	i am going	5
	i will go	5
	will go	5
	am going	4
	'll go	4
	i 'm	3
	'm going go	3
	i going going	2
	i 'd go	1
	going	1
	'm	1
	shall	1
	i will	1
kaatui	fell	11
	fell down	3
	have it	1
seuraavaksi	next	21

Source (English)	Target (Finnish)		Count
paid	maksoin	('I paid')	10
	maksetaan	('is paid')	10
	maksoi	('paid')	9
	minulle maksetaan	('I am paid')	7
	maksanut	('has paid')	7
	maksaa	('pays')	2
	makseta	('(is not) paid')	2
	maksettuun	('to a paid...')	1
	saa palkkansa	('gets his/her salary')	1
	kiinnittivät	('attached')	1
	maksettu	('paid for')	1
	saa palkkaa	('gets paid')	1
	maksettiin	('was paid')	1
	maksuni	('my payment')	1
	maksaisi	('would pay')	1
	työstä palkkaa	('salary from work')	1
	maksanu	('(did not) pay')	1
	tuotti tulosta	('paid off')	1
entirely	täysin	('completely')	23
	kokonaan	('fully')	6
	aivan	('exactly')	5
	ihan	('totally')	1
faking	teeskentelee	('pretends')	10
	esittää	('acts/performs')	5

Table 6.2: Examples of source-target counts from Tatoeba aligned by GIZA++.

Limiting data by minimum target count. Table 6.3 shows the number of source words in each translation direction, along with the mean/median number of targets per source and the mean/median number of words per target. The metrics are calculated for the minimum target counts of 1, 2, 5, 10, and 20. Increasing the minimum target count from 1 to 2 drops the number of source words drastically by discarding many unreliable single-case translations. After this the decline is steady but less steep with each increase of the minimum target count. The number of targets per source and words per target also systematically decrease. Based on manual evaluation, translations with low target counts were commonly incorrect, which motivated discarding them. For the experiments, I used the minimum target count of 10.

term would be "token", but since I adopt this term in a different sense (see Sections 6.3–6.4), I use "word" here.

[10] Applying alignment to both directions on the same corpus uncovers word-to-phrase translations both from Finnish to English and from English to Finnish. In contrast, it does not yield phrase-to-phrase translations, where both the source and target contain multiple tokens. While phrase-to-phrase translations cannot be obtained automatically with GIZA++, some results on unit shifts are relevant for them (see Sections 6.3 and 6.6).

Direction	Min. count	Source words	Targets/source		Words/target	
			Mean	Median	Mean	Median
Finnish-English	1	52588	1.90	1	1.85	2
	2	16814	1.81	1	1.54	1
	5	5757	1.66	1	1.36	1
	10	**2885**	**1.56**	**1**	**1.29**	**1**
	20	1477	1.49	1	1.23	1
English-Finnish	1	17269	4.53	2	1.47	1
	2	6497	4.07	2	1.15	1
	5	2665	3.42	2	1.06	1
	10	**1557**	**2.90**	**2**	**1.05**	**1**
	20	924	2.45	1	1.04	1

Table 6.3: Statistics of Finnish-English translations from Tatoeba (minimum count of 10 used).

Obtaining translation shifts. From the GIZA++ alignment, I extracted two kinds of translation shifts automatically: *unit shifts* and *word-order shifts*. In unit shifts, a single source word is translated to multiple target words or vice versa (Catford 1965: 79). The target words do not need to be adjacent in the target text. In the present data, unit shifts are equivalent with cases where the target contains more than one word, since GIZA++ requires the source to be a single word. Word-order shifts are defined as translations that satisfy the following criteria: (i) A_1 translates to B_1, (ii) A_2 translates to B_2, (iii) A_1 precedes A_2, and (iv) B_2 precedes B_1. I limited these to cases where each of $\{A_1, A_2, B_1, B_2\}$ is a single word. Hence, word-order shifts and unit shifts do not overlap.

Superficial POS labels. I subsequently manually labeled each type of translation shift based on the following part-of-speech (POS) classes: *adjective* (ADJ), *adverb* (ADV), *auxiliary verb* (AUX), *complementizer* (CMP), *connective* (CNN), *copula* (COP),[11] *degree adverbial* (DEG), *determiner* (DET), *expletive subject* (EXP), *noun* (N), *negation* (NEG), *numeral* (NUM), *pre-/postposition* (P), *pronoun* (PRN), *relative pronoun* (REL), *verb* (V), and *wh-pronoun* (WH). These are based on standard descriptive grammars, such as Quirk et al. (1985) for English or Hakulinen et al. (2004) for Finnish. As such, they are deliberately superficial and independent of more elaborate assumptions. I introduced each label as needed based on the data. Sections 6.3–6.4 give further details, and all annotated data is provided in Appendix A.

Syntactic analysis. After the superficial POS-tag labeling, I analyzed each translation shift type with the theoretical framework developed in Chapters 3–5. For the syntactic specifics, I relied on prior generative literature on English (as surveyed in e.g. Adger 2003, Radford 2004, 2009, and Carnie 2013) and Finnish (e.g. Vainikka 1989, Holmberg et al. 1993, Holmberg and Nikanne 2002, Huhmarniemi 2012, Brattico et al. 2014, Saikkonen 2018). When needed,

[11] I use "copula" in a broad sense covering all verbs that have the copula's surface form, including auxiliaries.

I modified the analyses to fit the linguistic framework of Chapter 3, minimizing the required alterations. Beyond this, I introduced no novel syntactic proposals as such; all analyses I relied on have been independently motivated in prior literature. Section 6.5 provides the results.

Software. Word alignment with GIZA++, limiting the data via the minimum target count, and obtaining translation shifts of both kinds are fully automated tasks. I programmed the pipeline for running these in a sequence with Python 3. The library includes functions for obtaining unit and word-order shifts from any parallel corpus aligned with GIZA++. The source code is available as open-source in the GitHub repository, along with instructions on its use.[12]

6.3 Unit shifts

I assigned unit shifts in both translation directions to classes shown in Table 6.4. Except for "LEX" and "other", the labels denote categories of target words that lack a source correlate. For example, the label "EXP" means that the target contains an expletive subject in addition to the translation of the source word.

To advance subsequent stages of analysis (see Section 6.5), I included additional syntactic details for some labels. Since the copula verb was only added to English participial verbs (containing the suffix *-ing*), passive verbs, or a negation, I treated these variants of the copula unit shift as dedicated labels (COP-ING, COP-PASS, and COP-NEG, respectively). For negation, I added the information of whether it was added to a verb phrase (NEG-V) or a noun phrase (NEG-N). In pronouns, I distinguished between subjects (PRN-SUBJ), possessors (PRN-POSS), and syntactic complements such as *me* in the PP *with me* (PRN-COMP). Finally, I included an additional label for the English infinitival marker *to* (TO).

The labels are further divided into three high-level classes: *syntactic*, *orthographic*, and *lexical*. Syntactic unit shifts contain a clear single-word translation of the source word, but also add syntactic material due to grammatical requirements of the target language. Orthographic shifts occur merely due to superficial differences between the source and target language's writing conventions. These came in three kinds: separating compound words (COM), changing digits into numerals or vice versa (NUM), and adding punctuation (PCT). Lexical shifts arise due to neither syntactic nor orthographic reasons, but instead from the source word itself being translated to a multi-word target. These are discussed further in Section 6.6.

[12] `https://github.com/tombgro/translation-analysis`

Annotation		Added word(s) in the target	Type
AUX		auxiliary verb	Syntactic
CMP		complementizer	
CNN		connective	
COP	COP-ING	copula verb with present participle (*-ing* in English)	
	COP-NEG	copula verb with negation	
	COP-PASS	copula verb with passive voice	
DEG		degree adverbial	
DET		determiner	
EXP		expletive subject	
NEG	NEG-V	negation for a verb (phrase)	
	NEG-N	negation for a noun (phrase)	
P		adposition	
PRN	PRN-SUBJ	subject pronoun	
	PRN-POSS	possessor pronoun	
	PRN-COMP	complement pronoun	
REL		relative pronoun	
TO		*to* in English infinitival clauses	
V		non-auxiliary verb	
WH		*wh*-word	
COM		whitespace between constituent words in a compound	Orthographic
NUM		digit to characters or vice versa	
PCT		punctuation	
LEX		multi-word translation of the source for a non-grammatical reason	Lexical
other		not classified to any other class	Other

Table 6.4: Manual annotation classes for unit shifts.

Syntactic, lexical, and orthographic labels covered 99.1% of Finnish-English unit shifts and 97.1% of English-Finnish unit shifts. The remaining shifts were allocated to the “other” label. While not errors as such (which were discarded), these were typically border-line cases in acceptability (in my personal assessment), often involving the addition of particles or highly context-dependent target material. They are not analyzed in Sections 6.3.1–6.3.2 due to their varied nature and unclear acceptability.

Table 6.5 displays the unit shift results in both directions from the Finnish-English Tatoeba corpus. The results are given in a descending order from the most to the least common classes of unit shifts based on the number of datapoints – i.e. *tokens* – covered by each unit shift. The table also shows the number of different *types* of shifts each label covers, which may cover multiple tokens. Note that more than one unit shift can occur in a single translation, which allows possible overlap between classes across datapoints.

Section 6.3.1 covers Finnish-English unit shifts, and Section 6.3.2 English-Finnish unit shifts. After a description of each shift, example translations from Tatoeba are given for illustration, with the relevant words marked in bold. For syntactic shifts covering multiple types, two examples illustrating different types are given. For syntactic shifts present only in a single type as well as all orthographic shifts, one example is shown. Section 6.6 then provides more thorough discussion of lexical unit shifts in both directions.

Finnish-English		
Annotation	**Tokens (%)**	**Types**
PRN-SUBJ	16576 (43.5%)	287
AUX	7411 (19.5%)	164
P	5180 (13.6%)	234
LEX	3866 (10.2%)	128
PRN-POSS	1646 (4.3%)	86
DET	645 (1.7%)	35
COP-ING	577 (1.5%)	32
COP-NEG	457 (1.2%)	9
COM	358 (0.9%)	18
other	335 (0.9%)	21
WH	259 (0.7%)	10
NEG-N	174 (0.5%)	3
PRN-COMP	131 (0.3%)	7
PCT	117 (0.3%)	5
COP-PASS	106 (0.3%)	5
EXP	91 (0.2%)	6
TO	82 (0.2%)	5
DEG	39 (0.1%)	2
CNN	12 (0.0%)	1
CMP	11 (0.0%)	1
all	38073	1059

English-Finnish		
Annotation	**Tokens (%)**	**Types**
LEX	1889 (34.6%)	75
COP-NEG	1211 (22.2%)	6
NEG-V	1102 (20.2%)	15
CMP	730 (13.4%)	16
other	157 (2.9%)	3
PRN-COMP	94 (1.7%)	6
REL	53 (1.0%)	3
NUM	52 (1.0%)	2
PCT	49 (0.9%)	2
DET	37 (0.7%)	2
EXP	36 (0.7%)	1
AUX	25 (0.5%)	2
PRN-POSS	17 (0.3%)	1
all	5452	134

Table 6.5: Manually annotated unit shifts.

6.3.1 Finnish-English

In the Finnish-English direction, 1132 unit shift types were identified. I manually classified each type to the classes in Table 6.4 or as an error by GIZA++. Of these types, 73 were errors.[13] Of the remaining 1059 types, 21 were labeled as "other", not belonging to any of the syntactic or lexical classes. These made up 0.9% of the tokens, and hence the analysis covers 99.1% of the (non-erroneous) Finnish-English unit shifts: 37738 tokens across 1038 types. Each class is described below, in descending order based on the number of tokens.

PRN-SUBJ. Clearly the most common Finnish-English unit shift was the insertion of a subject pronoun in the translation of a Finnish sentence that used pro-drop. Subject addition took place 16576 times with 287 verbs.

(97) a. **olen** lainannut kaksi kirjaa
have.1SG.PRES borrow.PCP.PAST two book.PART
'I have borrowed two books'

b. **i have** borrowed two books[14]

[13]These were, in my judgement, not appropriate translations in any possible context. I also discarded all unit shifts that lacked any source word as errors (marked as the source being "NULL" by GIZA++), of which there were 94.

[14]The raw data is lowercased, and I follow this notation in the examples taken from there. In my own translations (in single quotes under glosses), I use standard English capitalization.

(98) a. **voit** mennä minne ikinä haluat
can.2SG go where.ILL ever want.2SG.PRES
'You can go wherever you want.

b. **you can** go wherever you want to go

AUX. A significant subset of Finnish-English unit shifts involved added auxiliaries. This was primarily present in negations (*do* filling T as opposed the Finnish verb raising), questions (*do* in C as opposed to the Finnish verb raising), and *will* used for future tense as opposed to Finnish lacking a future marker. Auxiliary addition took place 7411 times across 164 verbs.

(99) a. tom ei **tullut** kotiin viime yönä
tom NEG come.PCP.PAST home.ILL last night.ESS
'Tom did not come home last night'

b. tom **didn** 't **come** home last night

(100) a. mitä ? mitä sinä **sanoit** ?
what what you say.2SG.PAST
'What? What did you say?'

b. what ? what **did** you **say** ?

P. The correlate of Finnish case marking is the preposition system in English, resulting in the addition of prepositions forming a major part of Finnish-English unit shifts. Prepositions were mostly added to nouns to translate Finnish case marking, but also to complements of verbs (e.g. *listen to*), adjectives (e.g. *proud of*), or nouns (e.g. *end of*). Overall, this resulted in 5180 tokens across 234 types.

(101) a. tomi on nyt **vaarassa**
tom be.3SG.PRES now danger.INE
'Tom is now in danger'

b. tom is now **in danger**

(102) a. olen tosi **kiinnostunut** musiikista
be.1SG.PRES very interested music.ELA
'I am very interested in music'

b. i 'm very **interested in** music

LEX. Of Finnish-English unit shifts, 10.2% were due to genuine lexical differences between the languages, comprising 3866 tokens across 128 types. The two most common lexical unit shifts were *minulla/sinulla* → *i/you have* (lit. 'in my/your possession') and *minusta* → *i think* (lit. 'from me' interpreted as 'in my view') Section 6.6 covers lexical unit shifts in more detail.

(103) a. **minulla** on vähän rahaa
1SG.ADE be.3SG.PRES little money.PART
'I have a little money'

b. **i have** a little money

(104) a. **minusta** se on tosi hienoa
1SG.ELA 3SG be.3SG.PRES very nice
'In my view it is very nice'

b. **i think** that's great

PRN-POSS. Possessor pronoun addition was motivated by the same reason as subject pronoun addition (see above): English lacking pro-drop. A possessor pronoun was added 1646 times across 86 nouns.

(105) a. **autoni** on saksalainen
car.1SG-POSS be.3SG.PRES german
'My car is German'

b. **my car** is german

(106) a. tapasin **isäsi** eilen
met.1SG.PAST father.2SG-POSS yesterday
'I met your father yesterday'

b. i met **your father** yesterday

DET. Finnish lacks mandatory determiners, and their addition in English brought about 645 unit shift tokens across 35 types. The clear majority of these involved the addition of the definite article *the* (384 tokens across 18 types), followed by the addition of the indefinite article *a/an* (219 tokens across 14 types), and the quantifier *some* (42 tokens across 3 types). Added determiners were directly adjacent to a noun in 538 unit shift tokens across 28 types, and to noun modifiers in 107 tokens across 7 types.

(107) a. **aurinko** vajosi **pilvien** alle
sun sink.3SG.PAST cloud.PL.GEN below
'The sun sunk below (the) clouds'

b. **the sun** sunk below **the clouds**

(108) a. anna minulle **lisää** teetä
give.IMP 1SG.ILL more tea.PART
'Give me more tea'

b. give me **some more** tea

COP-ING. Finnish marks progressive aspect via object case rather than verb inflection as in English. In English, aspect marking involves the insertion of the copula auxiliary (*be*) in the T-position, which resulted in 577 unit shift tokens across 32 types.

(109) a. tom **opiskelee** ranskaa
tom study.3SG.PRES french.PART
'Tom studies French / Tom is studying French'

b. tom **is studying** french

(110) a. hän **istui** puun alla
3SG sit.3SG.PAST tree.GEN under
'(S)he sat under a tree / (S)he was sitting under a tree'

b. she **was sitting** under a tree

COP-NEG. The Finnish negation auxiliary *ei* was translated to a combination of the English negation with the copula verb in 457 tokens across 9 types.

(111) a. tomi on opettajasi , **eikö** niin ?
tom be.3SG.PRES teacher.2SG-POSS NEG-Q so
'Tom is your teacher, isn't that so?'

b. tom is your teacher , **isn 't** he ?

(112) a. tomia **ei** kiinnosta politiikka
tom.PART NEG interest.PRES politics
'Tom is not interested in politics'

b. tom **is not** interested in politics

COM. Constituents of compound words are written together in Finnish but separately in English. This superficial ortographic difference covered 358 unit shift tokens across 18 types.

(113) a. haluaisitko vähän lisää **appelsiinimehua** ?
want.2SG.COND-Q little more orange-juice.PART
'Would you like a little more orange juice?'

b. would you like some more **orange juice** ?

WH. Finnish contains the question particle *-ko*, which lacks a direct morphological correlate in English. However, in certain contexts its use conforms to that of the English *wh*-adverb *how*, as in e.g. *montako* $\rightarrow$ *how many*. This took place in 114 unit shift tokens across 3 types. Other *wh*-word-based unit shifts were the translation of *pystynkö* to *whether I can* (48 tokens), *monelta* to *what time* (21 tokens),[15] and different variants of *miksei* (‘why-not’) to *why don’t* or *why not* (40 tokens). In addition, *millaista* (‘what-kind.PART’) was translated to *what (...) like* in 24 tokens, and *millainen* (‘what-kind.NOM’) to *what kind of* in 12 tokens. Overall, *wh*-pronoun addition took place 259 times across 10 types.

(114) a. **montako** kitaraa omistat ?
many-Q guitar.PART own.2SG.PRES
‘How many guitars do you own?’

b. **how many** guitars do you own ?

(115) a. **millainen** auto sinulla on ?
what-kind car 2SG.ADE be.3SG.PRES
‘What kind of a car do you have?’

b. **what kind of** car do you drive ?

NEG-N. Finnish lacks a negative quantifier corresponding to the English *no*. This was added in 3 unit shifts, covering 174 tokens altogether. First, *aavistustakaan* was translated to *no idea* (24 tokens), where *-kaan* is the negative variant of the particle *-kin*, roughly meaning ‘also’ or ‘as well’. Second, the pronouns *kukaan* and *ketään* were both translated to *no one* (132 and 18 tokens, respectively). These are polarity items that must occur in the scope of a negation in Finnish; whereas the English translation is a noun phrase with the negative quantifier, appearing in an affirmed clause.

(116) a. minulla ei ole **aavistustakaan** mihin hän on
1SG.ADE NEG be.PRES idea-KIN where.ILL 3SG have.3SG.PRES
mennyt
go.PCP.PAST
‘I have no idea where (s)he has gone’

b. i have **no idea** where he has gone

(117) a. **kukaan** ei voi pysäyttää minua
anyone NEG can.PRES stop 1SG.PART
‘No one can stop me’

b. **no one** can stop me

PRN-COMP. Finnish pro-drop resulted in adding pronouns to the complements of connectives or prepositions in 131 tokens across 7 types. Most added a pronoun to correspond to the

[15] *Monelta* is a reduced colloquial variant of *moneltako* with the *-ko* particle dropped. Assuming this particle still to be present in NS (given its interpretation at SEM), this unit shift is thus covered by the general account where the morphologically bound *-ko* is translated to an independent *wh*-word in English.

Finnish possessive suffix in an adposition, such as *kanssa* ('with') or *mukaan* ('along/with'). I also include here the addition of the subject pronoun marked on the Finnish negated connective *jollet*, translated to *unless you*.

(118) a. tomin pitäisi tulla **mukaani**
tom.GEN should come with.1SG-POSS
'Tom should come with me'

b. tom should come **with me**

(119) a. et saa koskaan tietää , **jollet** yritä
NEG.2SG get.PRES ever know if.NEG.2SG try
'You will never find out if you do not try'

b. you 'll never know **unless you** try

PCT. Punctuation-based superficial unit shifts took place across 117 tokens and 5 types, all based on the addition of a comma in English.

(120) a. **valitettavasti** koko homma meni pieleen
unfortunately whole thing go.3SG.PAST wrong
'Unfortunately the whole thing went wrong'

b. **unfortunately ,** the whole thing fell apart

COP-PASS. Finnish passive inflection is based on verb morphology, whereas English uses a copula auxiliary to indicate passive voice. This manifested as the addition of a copula in 26 tokens with the translations *voidaan* ('can.PASS') $\rightarrow$ *can be* and *kutsutaan* ('call.PASS') $\rightarrow$ *is called*. In addition, *syntyä* (lit. 'originate') was translated to *be born* across 69 tokens, and *kiinnostaako* ('interest-Q') to *are interested* across 11 tokens. In the latter two cases, a Finnish active verb lacks a direct active voice translation, and a passive English verb is used instead. There were 106 COP-PASS shifts covering 5 types altogether.

(121) a. tuota planeettaa **kutsutaan** saturnukseksi
that.PART planet.PART call.PASS saturn.TRANSL
'That planet is called Saturn'

b. that planet **is called** saturn

(122) a. tom **syntyi** bostonissa
tom be-born.3SG.PAST boston.INE
'Tom was born in Boston'

b. tom **was born** in boston

EXP. Written Finnish lacking expletive pronouns, their addition accounted for 91 unit shifts across 6 types with the verbs *sataa→rain* and *näyttää→look/seem*.

(123) a. kesäkuussa japanissa **sataa** paljon
july.INE japan.INE rain.3SG.PRES much
'In June in Japan it rains a lot'

b. **it rains** a lot in june in japan

(124) a. **näyttää** siltä , että tom on rakastunut
seem.3SG.PRES 3SG.ABL that tom be.3SG.PRES in-love
'It looks like Tom is in love'

b. **it looks** like tom is in love

TO. Infinitival verbs are marked morphologically in Finnish, while in English they require the particle *to* in the T-position. This accounted for 49 unit shifts covering 3 types. In addition, non-infinitival Finnish source constructions were translated to English infinitival verbs across 33 tokens and 2 types: *syötävää → to eat* (21 tokens; lit. 'edible') and *tehtävänä → to do* (12 tokens; lit. 'as assignment'). Overall, the addition of the infinitival *to* accounted for 82 unit shifts across 5 types.

(125) a. tom tahtoi **käydä** amerikassa
tom want.3SG.PAST visit america.INE
'Tom wanted to visit America'

b. tom wanted **to visit** america

(126) a. sinulla on töitä **tehtävänä**
you.ADE be.3SG.PRES work.PL.PART assignment.ESS
'You have work to do'

b. you have work **to do**

DEG. Comparative and superlative markers are affixes in Finnish, while in English they are stand-alone morphemes for adjectives/adverbs with two or more syllables. *More* was added in 13 tokens (all for *hitaammin → more slowly*), and *most* in 26 tokens (all for *kaunein → most beautiful*). This resulted in 39 tokens across 2 types overall.

(127) a. voisitko puhua **hitaammin** ?
could.2SG.COND-Q speak slow.COMP
'Could you speak more slowly?'

b. please speak **more slowly**

(128) a. missä on maailman **kaunein** paikka ?
where.INE be.3SG.PRES world.GEN beautiful.SUPERL place
'Where is the world's most beautiful place?'

b. where is the **most beautiful** place in the world ?

CNN. The adjective *vanhemman* ('older.GEN') was translated to *and elder* 12 times. While this initially seems like a mistake, investigation of the translations revealed that it arose from a Finnish participial clause (*vanhemman jäädessä paikalleen*; lit. 'the elder remaining in place') being translated to an embedded clause in English (*and the elder remained behind*).

(129) a. sitten nuorempi sisarus lähti matkaan **vanhemman**
then young.COMP sibling go.3SG.PAST trip.ILL old.COMP.GEN
jäädessä paikalleen
stay.PCP.PRES place.ILL.3SG-POSS
'Then the younger sibling started to travel while the older one stayed in place'

b. then the younger sibling set off , **and** the **elder** remained behind

CMP. The translation *onkohan* $\rightarrow$ *I wonder if* (11 tokens) adds both a subject pronoun and the C-particle *if*, which begins the embedded clause. This is contrasted by the Finnish source, which contains two C-particles: *-ko* and *-han*, the first marking a question and the second usually emphasis but in this context wonderment or the lack of certainty. English lacks the indirect question construction in *yes/no* questions, and hence uses other means for marking the embedded clause.

(130) a. **onkohan** muilla planeetoilla elämää ?
be.3SG.PRES-Q-HAN other.PL.ADE planet.PL.ADE life.PART
'I wonder: is there life on other planets?'

b. **i wonder if** life exists on other planets

Summary. Of Finnish-English unit-shifts, 87.7% were syntactic (33397 tokens across 887 types), 10.2% lexical (3866 tokens across 128 types), and 1.2% orthographic (475 tokens across 23 types). Together, these covered 99.1% of all Finnish-English unit-shifts.

6.3.2 English-Finnish

English-Finnish unit shifts covered 168 unit shift types, of which I classified 34 as erroneous mappings by GIZA++.[16] Of the remainder, 3 types were classified as "other", which took 2.9% of the tokens. The present analysis thus covers 97.1% of the unit shifts.

[16] In addition, I discarded 26 shifts that had no source word ("NULL" source in GIZA++).

LEX. In contrast to Finnish-English, the largest English-Finnish unit shift class was lexically motivated, making up 34.6% of all unit shifts (1889 tokens across 75 types). The most common types were *never* → *ei koskaan* (lit. 'not ever': 236 tokens) and *before* → *ennen kuin* (lit. 'before than': 168 tokens). Section 6.6 covers lexical unit shifts in more detail.

(131) a. he **never** tells lies

b. hän **ei** **koskaan** valehtele
3SG NEG ever lie
'(S)he never lies'

(132) a. knock **before** coming in

b. koputa **ennen kuin** tulet sisään
knock.IMP before than come.2SG.PRES inside.ILL
'Knock before you come in'

COP-NEG GIZA++ systematically translated the English negation to the sequence of the Finnish negation and the copula, leaving the English copula untranslated. While this is strictly speaking an error, I treat it as a unit shift due to its systematicity, as it accounts for 701 unit shifts across 4 types (arising from tense and person inflection of the copula). In addition, the English negation quantifier (*no*) was translated to the Finnish negation auxiliary (*ei*) in 510 tokens across 2 types. This reflects the fact that Finnish lacks a negation quantifier, and uses negation only in the clause. Overall, this amounts to 1211 unit shifts across 6 types.

(133) a. the knife is **not** sharp

b. veitsi **ei** **ole** terävä
knife NEG be.PRES sharp
'a/the knife is not sharp'

(134) a. we have **no** alternatives

b. meillä **ei** **ole** vaihtoehtoja
1PL.ADE NEG be.PRES alternative.PL.PART
'we do not have alternatives'

NEG-V. These unit shifts arise from the contracted English negation (*n't*) being attached to the auxiliary or copula, while being translated to the stand-alone negation in Finnish. This covered 980 tokens across 14 types. Finnish also has no direct translation of the pronoun *nobody*, but instead uses negated clauses with *kukaan* ('anybody') that must appear in the scope of a negation. This resulted in the addition of a negation in the translation *nobody* → *kukaan ei* in 122 tokens. Hence, there were 1102 NEG-V shifts across 15 types altogether.

(135) a. it **wasn** ’t my intention

b. se **ei ollut** tarkoitukseni
3SG NEG be.PAST purpose.1SG-POSS
‘It was not my purpose’

(136) a. **nobody** can stop me !

b. **kukaan ei** voi pysäyttää minua !
anyone NEG can.PRES stop 1SG.PART
‘Nobody can stop be !’

CMP. English allows some embedded clauses to appear without an overt complementizer, whereas Finnish requires all embedded clauses to be introduced by a complementizer. The complementizer *että* (‘that’) was added in 689 tokens across 13 types, and the complementizer *kun* (‘when’) in 41 tokens across 3 types. Overall, this amounted to 730 tokens across 16 types.

(137) a. i **think** i should clean my room

b. **luulen että** minun pitäisi siivota huoneeni
think.1SG.PRES that 1SG.GEN should clean room.1SG-POSS
‘I think that I should clean my room’

(138) a. **while** you drive , you should focus on the road

b. **silloin kun** ajatte , teidän pitäisi keskittyä tiehen
then when drive.2PL.PRES 2PL.GEN should concentrate road.ILL
‘When you drive, you should concentrate on the road’

PRN-COMP. The third person non-human singular pronoun *se* was added to adjectives in 50 tokens and 3 types (e.g. *sure* $\rightarrow$ *varma siitä*); to two verbs in 33 tokens (*seems* $\rightarrow$ *vaikuttaa/näyttää siltä*); and to the noun *käsitys* in 11 tokens (*idea* $\rightarrow$ *mitään käsitystä siitä*; see below for discussion of *mitään*). Overall, this made up 94 tokens across 6 types.

(139) a. i ’m not **sure** what he was thinking

b. en ole **varma siitä** , mitä hän ajatteli
NEG.1SG be.PRES certain 3SG.ILL what.PART 3SG think.3SG.PAST
‘I am not certain about what (s)he was thinking’

(140) a. i have no **idea** where tom is now

b. minulla ei ole **mitään käsitystä siitä** , missä tom on nyt
1SG.ADE NEG be.PRES any idea.PART 3SG.PART where.INE tom be.3SG.PRES now
‘I do not have any idea of where Tom is now’

REL. As with complementizers (see above), English allows covert relative pronouns in certain contexts, while Finnish requires all relative pronouns to be overt. A relative pronoun *joka/mikä* was added to nouns in 53 tokens and 3 types.

(141) a. forget **everything** i told you !

b. unohtakaa **kaikki** **mitä** sanoin teille !
forget.PL.IMP everything REL.PART say.1SG.PAST 2PL.ILL
'Forger everything that I told you!'

(142) a. i was rereading the **letters** you sent to me

b. olin lukemassa uudestaan **kirjeitä** , **jotka** sinä
be.1SG.PAST read.PCP.INE again letter.PL.PART REL.PL 2SG
lähetit minulle
send.2SG.PAST 1SG.ILL
'I was again reading the letters that you sent to me'

NUM. These superficial unit shifts are due to a numeral (e.g. -1) being spelled out in letters (e.g. *miinus yksi*: lit. 'minus one'), and cover 52 tokens across 2 types.

(143) a. the functions sine and cosine take values between **-1** and **1** (-1 and 1 included)

b. sini- ja kosinifunktiot ottavat arvoja **miinus yhden** ja
sine and cosine-function.PL take.3PL.PRES value.PL minus one.GEN and
yhden väliltä , -1 ja 1 mukaanlukien
one.GEN between.ABL -1 and 1 included
'Sine and cosine functions take values between one and minus one, -1 and 1 included'

PCT. The addition of a case marker to the abbreviated noun *tv* resulted in the ortographic separation of the case marker from the noun via a colon (*tv : tä*, *tv : ssä*) in 49 tokens across 2 types.

(144) a. tom has been watching **tv** all day

b. tom on katsonut **tv** : **tä** kaiken päivää
tom be.3SG.PRES watch.PCP.PAST tv PART all.GEN day.PART
'Tom has been watching tv all day'

DET. Lacking a negative quantifier ('no'), Finnish uses negated clauses instead. This resulted in the *prima facie* strange translation *idea* $\rightarrow$ *mitään käsitystä siitä*, where *käsitys* is the translation of *idea*, the partitive case *-tä* marks agreement with a negation, and *mitään* is a quantifier meaning ‘any’. (*Siitä* is a pronoun required for the introduction of an embedded clause to follow, instantiating the PRN-COMP shift discussed above.) In addition, the pronoun *se* was sometimes added for definite noun phrases; and while this would be more appropriately translated as a definite article (Laury 1997, Gröndahl 2014), GIZA++ allocated it to the translation of the head noun. Determiner addition accounted for 37 tokens across 2 types.

(145) a. i have no **idea** where tom is now

b. minulla ei ole **mitään käsitystä siitä** , missä tom
1SG.ADE NEG be.PRES any idea.PART 3SG.PART where.INE tom
on nyt
be.3SG.PRES now
‘I do not have any idea of where Tom is now’

(146) a. do you sing in the **choir** ?

b. laulatteko te **siinä kuorossa** ?
sing.2PL.PRES-Q 2PL 3SG.INE choir.INE
‘Do you sing in that choir?’

EXP. Since written Finnish lacks a correlate for the impersonal pronoun *you*, English source sentences containing it were translated using the Finnish expletive *sitä* in 36 tokens. Here, the expletive was treated as part of the verb *saa* translated from the modal auxiliary *’ll* in *you’ll* constructions.

(147) a. you **’ll** never know unless you try

b. ei **sitä saa** koskaan tietää , ellei yritä
NEG EXP get.PRES ever know if-NEG try
‘One never gets to know unless one tries’

AUX. The modal auxiliary *could* was translated to *olisi voinut* on 25 occasions, 14 of which appeared with the affirmed form *could* and 11 with the negated form *couldn*.

(148) a. i **could** never have imagined that something like this existed

b. en **olisi voinut** koskaan kuvitellakaan , että jotain
NEG.1SG have.COND can.PCP.PAST ever imagine-KIN that something
tällaista voisi olla
such.ELA could.COND be
‘I could never have even imagined that something like this could exist’

(149) a. your timing **couldn** ’t be better

b. ajoituksesi ei **olisi** **voinut** olla parempi
timing.2SG-POSS NEG have.COND can.PCP.PAST be good.CMP
'Your timing could not have been better'

PRN-POSS. *After* was translated to *sen jälkeen kun* 17 times. The word alone translates to *jälkeen*, but this is a postposition that cannot precede a noun. Especially if the complement noun is long and thereby facilitates right-branching (see Hawkins 1994), the word-order requirement can be circumvented by using the pronoun *se* as the syntactic complement of *jälkeen* and specifying the semantic argument of the relation as an embedded clause introduced by the complementizer *kun*.

(150) a. i 'll do my homework **after** i watch television

b. teen läksyt **sen** **jälkeen kun** olen
do.1SG.PRES homework.PL 3SG.GEN after when have.1SG.PRES
katsonut televisiota
watch.PCP.PAST television
'I will do homework after I have watched television'

Summary. Of English-Finnish unit-shifts, 61.5% were syntactic (3354 tokens across 54 types), 34.6% lexical (1889 tokens across 75 types), and 1% orthographic (52 tokens across 2 types). Together, these covered 97.1% of all English-Finnish unit-shifts.

6.4 Word-order shifts

Word-order shifts are defined as follows: (i) A_1 translates to B_1, (ii) A_2 translates to B_2, (iii) A_1 precedes A_2, and (iv) B_2 precedes B_1. I limited the investigation to cases where $\{A_1, A_2, B_1, B_2\}$ are all treated as single words by GIZA++. I manually divided these based on part-of-speech categories of the relevant words. In notation, "X-Y" means that POS category X precedes the POS category Y in English but succeeds it in Finnish.

Of all word-order shift types recognized by GIZA++, I classified 15 as mistakes (covering 283 tokens).[17] Information on the remaining 1950 tokens across 87 types is presented in Table 6.6. Below, I review each word-order shift type in the order of token count, and provide examples in the same way as in Sections 6.3.1–6.3.2.

[17] A mistaken word-order shift is not always a mistaken translation, although most mistakes were inappropriate translations as well. A counter-example was *stopped working* → *meni rikki* (lit. 'went broken'), which is an appropriate *idiomatic* phrasal translation. It is still a mistaken word-order shift, since there is no 1–1 translation between the single-word constituents.

First word (English)	Second word (Finnish)						
	ADV	AUX	CONJ	N	NEG	PRON	V
ADJ	46 (4) (2.4%)						
ADV	30 (2) (1.5%)		12 (1) (0.6%)				63 (4) (3.2%)
AUX	24 (1) (1.2%)				529 (15) (27.1%)	48 (3) (2.5%)	
CONN		12 (1) (0.6%)				12 (1) (0.6%)	24 (2) (1.2%)
COP	111 (5) (5.7%)			28 (2) (1.4%)	27 (2) (1.4%)	205 (10) (10.5%)	
N	22 (2) (1.1%)			10 (1) (0.5%)			
NEG						24 (2) (1.2%)	
NUM	14 (1) (0.7%)						
P			24 (1) (1.2%)	259 (5) (13.3%)		139 (5) (7.1%)	
PRON	83 (5) (4.3%)				22 (2) (1.1%)		33 (2) (1.7%)
V	89 (5) (4.6%)			49 (2) (2.5%)		11 (1) (0.6%)	

Table 6.6: Word-order shifts from the Finnish-English Tatoeba corpus.
1950 tokens and 87 types overall; format: "tokens (types) (ratio of tokens)"

AUX-NEG. The largest class of word-order shifts was due to the different order between auxiliaries and the negation, as in e.g. *can 't* → *ei voi*: 15 types covering 529 tokens.

(151) a. you **can 't** quit now

b. te **ette** **voi** lopettaa nyt
2PL NEG.2PL can.PRES quit now
'You cannot quit now'

(152) a. tom **couldn 't** control his anger

b. tomi **ei** **pystynyt** hallitsemaan vihaansa
tom NEG could.PAST control.PCP.ILL anger.3SG-POSS
'Tom could not control his anger'

P-N. Translating a preposition to a postposition resulted in 259 shifts across 5 types.

(153) a. i didn 't do anything **with tom**

b. en tehnyt mitään **tomin** **kanssa**
NEG.1SG do.PAST anything tom.GEN with
'I did not do anything with Tom'

(154) a. he smoked a cigar **after lunch**

b. hän poltti sikarin **lounaan** **jälkeen**
3SG smoke.3SG.PAST cigar.GEN lunch.GEN after
'(S)he smoked a cigar after lunch'

COP-PRON. In *wh*-questions, the Finnish copula stays in T while the English copula raises from T to C. This resulted in shifts between the copula and a subject pronoun, covering 10 types and 205 tokens.

(155) a. whose charger **is this** ?

b. keiden laturi **tämä on** ?
who.PL-POSS charger this is
'Whose charger is this?'

(156) a. who **are you** there with ?

b. kenen kanssa **sinä olet** siellä ?
who.GEN with 2SG be.2SG.PRES there
'Who are you there with?'

P-PRON. These shifts were due to the same reason as P-N, and all 139 tokens concerned the translation *with* → *kanssa* with 5 different pronouns.

(157) a. i don 't get along **with him**

b. minä en tule toimeen **hänen kanssaan**
1SG NEG.1SG come along 3SG.GEN with
'I do not get along with him/her'

(158) a. i had nothing in common **with them**

b. minulla ei ollut mitään yhteistä **heidän kanssaan**
1SG.GEN NEG be.PAST anything common.PART 3PL.GEN with
'I did not have anything in common with them'

COP-ADV. English tends to put adverbs after the whole verb phrase, while Finnish prefers the pre-verbal position for adverbs. With the copula verb, this resulted in 111 shifts across 5 types.

(159) a. i don 't know what **'s** going on around **here**

b. en tiedä , mitä **täällä on** tekeillään
NEG.1SG know.PRES what here be.3SG.PRES going-on
'I do not know what is going on here'

(160) a. it **'s now** your turn

b. **nyt on** sinun vuorosi
now be.3SG.PRES 2SG.GEN turn.2SG-POSS
'Now it is your turn'

V-ADV. This is the same shift as COP-ADV, but with other verbs than the copula. It resulted in 89 word-order shifts, comprising 5 types.

(161) a. you can't **do** that **anymore**

b. te ette **enää** voi **tehdä** tuota
2PL NEG.2PL anymore can.PRES do that
'You cannot do that anymore'

(162) a. you 'd better **go now**

b. **nyt** teidän olisi syytä **mennä**
now 2PL.GEN be.COND reason.PART go
'Now you had better go'

PRON-ADV. Like V-ADV, these shifts are due to adverb placement. Here, the adverb appears after a direct or indirect object pronoun in English, but before the pronoun in Finnish. These resulted in 5 shift types across 83 tokens.

(163) a. **you** can't do that **anymore**

b. **enää** **te** ette voi tehdä noin
anymore 2PL NEG.2PL can.PRES do that
'You cannot do that anymore'

(164) a. **you** had better go **now**

b. **nyt** **teidän** olisi parempi lähteä
now 2PL.GEN be.COND good.CMP leave
'Now you had better go'

ADV-V. The opposite pattern to V-ADV is present with the adverbs *just* and *only*. These covered 4 types across 63 tokens. Unlike V-ADV shifts, these differences are explained by V-T head-movement.

(165) a. i **just want** to take a picture

b. **haluan** **vain** ottaa kuvan
want.1SG.PRES only take picture.GEN
'I only want to take a picture'

(166) a. i **only speak** a little french

b. **puhun** **vain** hieman ranskaa
speak.1SG.PRES only little french.PART
'I only speak a little French'

V-N. Like with V-ADV, English puts PPs after the verb phrase, while in Finnish they tend to precede the verb. This resulted in the complement noun of a PP shifting order from post- to pre-verbal in English-Finnish translation across 2 types and 49 tokens.

(167) a. what **happened** to **tom** in boston ?

b. mitä **tomille** **tapahtui** bostonissa ?
what tom.ILL happen.3SG.PAST boston.INE
'What happened to Tom in Boston?'

(168) a. what **happened** to **tom** was a nightmare

b. se , mitä **tomille** **kävi** , oli yhtä painajaista
3SG what tom.ILL happen.3SG.PAST be.3SG.PAST one.PART nightmare.PART
'That which happened to Tom was a complete nightmare'

AUX-PRON. In *wh*-questions, English auxiliaries undergo T-to-C raising while Finnish verbs remain in T. This resulted in 33 shifts across 2 types. Additionally, the subject position is filled by an expletive pronoun in English but by a raised element in Finnish. This accounted for one shift type covering 15 tokens. Altogether, these shifts covered 48 tokens across 3 types.

(169) a. what **should i** do ?

b. mitä **minun** **pitäisi** tehdä ?
what 1SG.GEN should do
'What should I do'

(170) a. there **are** pine trees in **this** forest

b. **tässä** metsässä **on** petäjiä
this.GEN forest.GEN be.3SG.PRES pine-tree.PL.PART
'In this forest there are pine trees'

ADJ-ADV. This shift results from the same phenomenon as V-ADV, but with copula-adjective constructions as the foundation of the verb phrase: adverbs tend to succeed the verb phrase in English but precede the verb (or copula+adjective here) in Finnish. It accounted for 4 shift types covering 46 tokens.

(171) a. it 's not **cold today**

b. **tänään** ei ole **kylmä**
today NEG be.PRES cold
'Today it is not cold'

(172) a. you 'd **better** go **now**

b. **nyt** sinun olisi **parempi** lähteä
now 2SG.GEN be.COND good.CMP leave
'Now you had better leave'

PRON-V. In *yes/no*-questions, the main verb succeeds a subject (pronoun here) in English questions while preceding it in Finnish. This resulted in 2 shift types covering 33 tokens.

(173) a. do **you speak** chinese ?

b. **puhutko** **sinä** kiinaa ?
speak.2SG.PRES-Q 2SG chinese
'Do you speak Chinese'

(174) a. do **you know** something about it ?

b. **tiedätkö** **sinä** siitä jotain ?
know.2SG.PRES-Q 2SG 3SG.ILL something
'Do you know something about it?'

ADV-ADV. Differences in adverb and verb phrase order also manifest between multiple adverbs. *Ever again* was translated to *enää koskaan* (lit. 'again ever') 17 times, and *back soon* to *pian takaisin* (lit. 'soon back') 13 times, covering 30 shifts altogether.

(175) a. i 'll be **back soon**

b. minä tulen **pian takaisin**
1SG come.1SG.PRES soon back
'I will come back soon'

(176) a. let 's not **ever** do this **again**

b. ei tehdä tätä **enää** **koskaan**
NEG do this.PART anymore ever
'Let's not do this ever anymore'

COP-N. In English *wh*-questions, copula verbs raise from T to C and hence appear before the subject at Spec,TP. In Finnish *wh*-questions, verbs (including the copula) remain in T. This resulted in the copula preceeding the subject in English but succeeding it in Finnish across 2 types and 28 tokens.

(177) a. how sick **is tom** ?

b. kuinka sairas **tom on** ?
how sick tom be.3SG.PRES
'How sick is Tom?'

(178) a. why **is tom** so late ?

b. miksi **tom on** niin myöhässä ?
why tom be.3SG.PRES so late
'Why is Tom so late?'

COP-NEG. English negation succeeds the auxiliary/copula in T, while the Finnish negation precedes the T-position hosting the verb. The English copula also undergoes T-C movement in questions, while the Finnish copula remains in T. This is manifested in the translation *isn 't* $\rightarrow$ *ei ole* (lit. 'not is') in 10 tokens. Furthermore *was no* was translated to *ei olisi* (lit. 'not was/were') in 17 tokens, appearing in a conditional sentence (*if there was no...*). Here, the English negation is a determiner in the complement noun, replaced with the clausal negation in Finnish. Thus, COP-NEG shifts accounted for 27 shifts across 2 types overall.

(179) a. the problem **isn 't** that

b. se **ei** **ole** ongelma
3SG NEG be.PRES problem
'It is not a problem'

(180) a. if there **was no** sun , we would not be able to live

b. jos **ei** **olisi** aurinkoa , niin emme pystyisi elämään
if NEG be.3SG.COND sun.PART then NEG.1PL could.COND live.PCP.ILL
'If there was no sun, then we could not live'

CONN-V. In 12 Finnish translations of the same English sentence, the order was changed between a conditional sentence (*if...*) and the main sentence it modified. Since the main sentence contained two verbs (*forget* and *call*), the translations of both (*unohda* and *soittaa*, respectively) preceded the connective in Finnish while succeeding it in the English original. Counted as two distinct types, this yielded 24 shifts altogether.

(181) a. **if** you come to rio , don 't **forget** to **call** me to be your guide !

b. älä **unohda** **soittaa** minulle **jos** tulet rioon , niin minä
NEG.IMP forget call 1SG.ALL if come.2SG.PRES rio.ILL so 1SG
voin olla oppaasi !
can.1SG be guide.2SG-POSS
'Do not forget to call me if you come to Rio, so I can be your guide'

NEG-PRON. This was the most varied word-order shift in the underlying grammar. In 10 out of 11 translations of *'t this* to *tämä ei* (lit. 'this not'), the shift arose from the English original using an *I don't V this...* construction with the verb V expressing some type of personal opinion (*find*, *like*, *consider*). In Finnish these were translated by using the object of the opinion as the grammatical subject and the first person pronoun as an adverbial in front of the clause, as in *minusta tämä ei ole...* (lit. 'in my view this is not...'). The remaining *'t this* $\rightarrow$ *tämä ei* translation was due to T-to-C raising of the negated copula in English, similar to the COP-N shift. Another NEG-PRON shift was *'t it* → *se ei* in 13 tokens, which had a different source: in English these were all negated attitude ascriptions (*I don't think... it...*), while the Finnish translation used an adverbial such as *minusta* ('in my view') or *mielestäni* ('in my opinion') with a negated embedded clause. Negation-pronoun shifts thus covered 24 tokens from 2 types.

(182) a. i don **'t** consider **this** safe

b. minusta **tämä ei** ole turvallista
1SG.ELA this NEG be.PRES safe.PART
'In my opinion this is not safe'

(183) a. i don **'t** think **it** 's important

b. minusta **se ei** ole tärkeää
1SG.ELA 3SG NEG be.PRES important.PART
'In my opinion it is not important'

AUX-ADV. *Can anymore* was translated to *enää voi* (lit. 'anymore can') in 24 tokens, reflecting the same difference in adverb placement as manifested in other adverb-involving word-order shifts covered above.

(184) a. you **can** 't do that **anymore**

b. te ette **enää voi** tehdä tuota
2PL NEG.2PL anymore can.PRES do that
'You cannot do that anymore'

P-CONJ. *Between and* was translated to *ja välillä* (lit. 'and between') in 24 tokens, reflecting the difference between the preposition and postposition.

(185) a. there are only two primes **between** 10 **and** 14

b. kymmenen **ja** neljäntoista **välillä** on vain kaksi
ten.GEN and fourteen.GEN between be.3SG.PRES only two
alkulukua
prime-number.PART
'There are only two prime numbers between ten and fourteen'

N-ADV. These follow from the same adverb placement differences as other adverb-related shifts covered above, and resulted in 22 tokens across 2 types.

(186) a. she speaks **french fluently**

b. hän puhuu **sujuvasti ranskaa**
3SG speak.3SG.PRES fluently french
'(S)he speaks French fluently'

(187) a. my brother won ’t be at **home tomorrow**

b. veljeni ei ole **huomenna kotona**
brother.1SG-POSS NEG be.PRES tomorrow at-home
‘My brother is not at home tomorrow’

PRON-NEG. *You ’t* was translated to *ette te* (lit. ‘not you’) 11 times. While the subject normally precedes the negation in both Finnish and English, Finnish allows focusing the negation via raising it to C, reflected here. *He didn* was translated to *ettei hän* (lit. ‘that-not (s)he) 11 times. This was in the context of an embedded clause, where English does not require an overt C but Finnish does, and the negation can raise to the complementizer *että*. Overall, PRON-NEG shifts accounted for 22 word-order shifts across 2 types.

(188) a. **you** can **’t** do that anymore

b. **ette** **te** voi enää tehdä tuota
NEG.2PL 2PL can anymore do that
‘You cannot do that anymore’

(189) a. tom said **he didn** ’t speak french

b. tom sanoi , **ettei** **hän** puhunut ranskaa
tom say.3SG.PAST that-NEG 3SG speak.PCP.PAST french
‘Tom said that he did not speak French’

NUM-ADV. *One left* was translated to *jäljellä yksi* 14 times, reflecting the same adverb order distinction as V-ADV.

(190) a. there is only **one** can of meat **left**

b. siellä on **jäljellä** ainoastaan **yksi** purkki lihaa
there be.3SG.PRES remaining only one can meat.PART
‘There is only one can of meat left there’

ADV-CONJ. *And included* was translated to *mukaanlukien ja* (lit. ‘including and’) 12 times. Both Finnish and English allow the corresponding expressions *included/mukaanluettuna* and *including/mukaanlukien*. These also align in word-order, the first preceding the arguments and the latter succeeding them. Given their semantic equivalence, translation from one variant to another is freely allowed, as manifested in this shift. This can be done for e.g. stylistic reasons; for example, in my personal judgement *mukaanlukien* has a bit more fluent status than *mukaanluettuna*.

(191) a. the functions sine and cosine take values between -1 and 1 (-1 **and** 1 **included**)

b. sini- ja kosinifunktiot saavuttavat arvoja lukujen
sine and cosine-function.PL reach.3PL.PRES value.PL.PART number.PL.GEN
-1 ja 1 väliltä (**mukaanlukien** -1 **ja** 1)
-1 and 1 between.ELA including -1 and 1
'The sine and cosine functions get values between the numbers -1 and 1 (including -1 and 1)'

CONN-AUX. *If don* was translated to *älä jos* (lit. 'don't if') 12 times, reflecting the difference in the placement of the conditional clause before the main clause in English and after the main clause in Finnish.

(192) a. **if** you come to rio , **don** 't forget to call me to be your guide !

b. **älä** unohda soittaa minulle **jos** tulet rioon , niin voin
NEG.IMP forget call 1SG.ALL if come.2PL.PRES rio.ILL so can.1SG
olla oppaasi !
be guide.2SG-POSS
'Do not forget to call be if you come to Rio, so I can be your guide!'

CONN-PRON. *If me* was translated to *minulle jos* (lit. 'me if') 12 times, reflecting the same difference in conditional clause placement as CONN-AUX.

(193) a. **if** you come to rio , don 't forget to call **me** to be your guide !

b. älä unohda soittaa **minulle** **jos** tulet rioon , niin voin
NEG.IMP forget call 1SG.ALL if come.2PL.PRES rio.ILL so can.1SG
olla oppaasi !
be guide.2SG-POSS
'Do not forget to call be if you come to Rio, so I can be your guide!'

V-PRON. *Want anybody* was translated to *ketään halua* (lit. 'anybody want') in 11 tokens. In 8 of these, *ketään* appeared as the first element in the clause, plausibly indicating a focused position in Spec,CP. In the remaining 3, it appeared after *en minä* ('I do not'; lit. 'not I'), indicating a lower but still pre-verbal position. I interpret this as arising from verb position in relation to the object, although its precise source remains in need of further investigation.

(194) a. i do not **want anybody** else

b. **ketään** muuta minä en **halua**
anyone.PART else.PART 1SG NEG.1SG want.PRES
'Anobody else I do not want'

(195) a. i do not **want anybody** else

b. en minä **ketään** muuta **halua**
NEG.1SG 1SG anyone.PART else.PART want.PRES
'It is not anybody else that I want'

N-N. *End month* was translated to *kuun lopussa* (lit. 'month's end') 10 times. This again reflects the difference between argument order in Finnish and English PPs.

(196) a. my driver 's license expires at the **end** of this **month**

b. ajokorttini menee vanhaksi tämän **kuun** **lopussa**
driving-licence.2SG-POSS go.3SG.PRES old.TRANS this.GEN month.GEN end.INE
'My driver's licence expires at the end of this month'

Summary. All word-order shifts covered 1950 tokens across 87 types. Unlike unit shifts, all word-order shifts were syntactically motivated.

6.5 Syntactic analysis

The translation shifts covered in Sections 6.3–6.4 can be pooled into 21 classes: 19 syntactic classes together with lexical and orthographic shifts. Together, these cover 98.9% of all (non-erronous) translation shifts in the Finnish-English Tatoeba data. Table 6.7 collects all the classes in the order of translation shift tokens covered overall, when both unit shifts (in both directions) and word-order shifts are considered.

This section analyzes the syntactic translation shift classes using the theoretical framework presented in Chapters 3–4. Syntactic classes cover 84.9% of all translation shifts. Sections 6.5.1–6.5.19 review each of the syntactic classes in the order of overall tokens covered, explaining their linguistic status in further detail.

Locus of variation	Unit shifts				Word-order shifts		Ratio of all 45475 tokens
	Finnish-English		English-Finnish				
	Classes	Tokens	Classes	Tokens	Classes	Tokens	
Pro-drop	PRN-SUBJ, PRN-POSS, PRN-COMP	18353	–	–	–	–	40.4%
Verb movement	AUX, COP-PASS	7517	–	–	COP-PRON, ADV-V, COP-N, AUX-PRON (33 tokens), PRON-V, PRON-NEG, NEG-PRON (1 token)	385	17.4%
Overt vs. covert P	P	5180	–	–	–	–	11.4%
Lexical differences	LEX	3866	LEX	1889	ADV-CONJ, NEG-PRON (23 tokens)	35	12.7%
Order of functional heads in the split TP	COP-NEG	457	COP-NEG, NEG-V (980 tokens), AUX	2216	AUX-NEG, COP-NEG (10 tokens)	539	7.1%
Covert complementizer	–	–	CMP	730	–	–	1.6%
Mandatory determiners	DET	645	–	–	–	–	1.4%
Aspect marking	COP-ING	577	–	–	–	–	1.3%
Orthography	COM, PCT	475	NUM, PCT	101	–	–	1.3%
Linearization of adverbs	–	–	–	–	V-ADV, PRON-ADV, COP-ADV, V-N, ADJ-ADV, ADV-ADV, AUX-ADV, N-ADV, NUM-ADV	468	1.0%
Pre- vs. postposition	–	–	PRN-POSS	17	P-N, P-PRON, P-CONJ, N-N	432	1.0%
Negative determiners	NEG-N	174	NEG-V (122 tokens), DET	159	COP-NEG (17 tokens)	17	0.8%
Question phrases	WH, CMP	270	–	–	–	–	0.6%
Expletive subjects	EXP	91	EXP	36	AUX-PRON (15 tokens)	15	0.3%
DP vs. CP argument	–	–	PRN-COMP	94	–	–	0.2%
Infinitive marking	TO	82	–	–	–	–	0.2%
Covert relative pronouns	–	–	REL	53	–	–	0.1%
Conditional clause position	–	–	–	–	CONN-V, CONN-AUX, CONN-PRON	48	0.1%
Degree adverbials	DEG	39	–	–	–	–	0.1%
Participials	CNN	12	–	–	–	–	$< 0.1\%$
Focusing	–	–	–	–	V-PRON	11	$< 0.1\%$

Table 6.7: Syntactic analysis of unit shifts and word-order shifts.

6.5.1 Pro-drop

English lacks pro-drop, while Finnish is a partial pro-drop language: it allows a covert pronoun (*pro*) in first and second person pronoun subjects of active verbs (Vainikka and Levy 1999, Holmberg 2005) as well as the possessor argument of noun phrases (Toivonen 2000). Assuming pronouns to be DPs lacking lexical content (e.g. Harley and Ritter 2002, Wiltschko 2002), this variation can be allocated to the availability of phonologically empty VIs for them.

There are different possible ways to analyze pro-drop syntactically. One possibility is that *pro* is simply a normal personal pronoun that has an empty VI in certain syntactic contexts, or is deleted at PF (e.g. Holmberg 2005). Other alternatives include treating *pro* as a syntactic category separate from overt pronouns (Chomsky 1982, Rizzi 1986) or denying the existence of *pro* and assigning the interpretation of the subject's features directly to verb agreement (Alexiadou and Anagnostopoulou 1998, Manzini and Savoia 2002). Here, I adopt the view that pro-drop involves a phonologically covert *pro*, but remain agnostic about its further lexical or syntactic properties.

Within the present linguistic framework, active clause subjects are base-generated to Spec,VoiceP (see Chapter 4, Section 4.3.2). In line with the overall exoskeletal approach to argument structure, I further assume that some functional projection in the extended nominal projection hosts the possessor, and use the placeholder "PossP" of this projection.[18] Consequently, Finnish licences the first or second person *pro* in Spec,VoiceP and Spec,PossP, whereas English lacks *pro* in total, as shown in (197)–(198):

(197) a. Finnish:

- VoiceP
  - DP
    - minä/pro_{1SG}
    - sinä/pro_{2SG}
    - hän/se
    - me/pro_{1PL}
    - te/pro_{2PL}
    - he/ne
  - Voice'
    - Voice
    - (...)
      - vP

b. English:

- VoiceP
  - DP
    - I
    - you
    - (s)he/it
    - we
    - you
    - they
  - Voice'
    - Voice
    - (...)
      - vP

[18]For discussion of PossP across different languages, see e.g. Szabolcsi (1994) for Hungarian, Tasseva-Kurktchieva (2004) for Bulgarian, and Haegeman and Danckaert (2013) for Flemish.

(198) a. Finnish:

PossP

DP | Poss'
minun/*pro*$_{1SG}$ | Poss (...)
sinun/*pro*$_{2SG}$ | nP
hänen/sen
meidän/*pro*$_{1PL}$
teidän/*pro*$_{2PL}$
heidän/niiden

b. English:

PossP

DP | Poss'
my | Poss (...)
your | nP
her/his/its
our
your
their

The resulting addition of pronouns accounted for 48.2% of Finnish-English unit shifts (PRN-SUBJ, PRN-POSS, PRN-COMP), and 40.4% of all translation shifts.

6.5.2 Verb movement

Adverb position has traditionally been treated as a criterion of verb movement to T (Pollock 1989, Belletti 1990, Dékány 2018). For example, English adverbs precede verbs while French adverbs succeed them, as shown by example (199) from Pollock (1989: 367; my glosses):

(199) a. *John kisses often Mary

b. John often kisses Mary

c. Jean embrasse souvent Marie
Jean kiss.3SG.PRES often Marie
'Jean often kisses Marie'

d. *Jean souvent embrasse Marie

Since the verb is syntactically lower in English than in French, the standard analysis has been that languages like French exhibit head-movement of the verb to T. The English verb, in contrast, remains in the lower position and receives the tense affix via some kind of a *lowering* operation, plausibly allocable to PF (e.g. Embick and Noyer 2001).

Verb movement to T has been assumed in generative work on Finnish (Vainikka 1989, Holmberg et al. 1993, Holmberg 2001, 2003, 2015, Holmberg and Nikanne 2002, Brattico and Huhmarniemi 2006, Brattico 2008a, Huhmarniemi 2012, Saikkonen 2018). The criterion of adverb position assigns Finnish to the same class as French: adverbs are typically post-verbal (Holmberg 1989). This is shown in (200) from Vainikka (1989: 60; my glosses):

(200) a. ?Pekka aina syö suklaata
Pekka always eat.3SG.PRES chocolate.PART
'Pekka always eats chocolate'

b. Pekka syö aina suklaata
Pekka eat.3SG.PRES always chocolate.PART
'Pekka always eats chocolate'

Finnish and English also differ with respect to verb movement to the C-domain. The English auxiliary or copula raises from T to C in both *yes/no*- and *wh*-questions, while Finnish verbs only raise to C in *yes/no*-questions (Holmberg 2001, 2003, 2014, 2015, Huhmarniemi 2012). This distinction is shown in (201)–(202), where the English copula raises above the subject in both the *yes/no*-question (201a) and the *wh*-question (201b), while the Finnish copula raises in the *yes/no*-question (202a) but not in the *wh*-question (202b):

(201) a. Is John ~~is~~ here ?

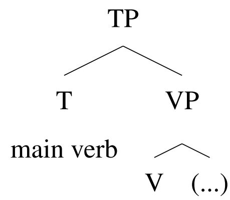
b. Where is John ~~is~~ ~~where~~ ?

(202) a. On-ko Pekka ~~on~~ täällä ?
be.3SG.PRES-Q Pekka here.INE
'Is Pekka here?'

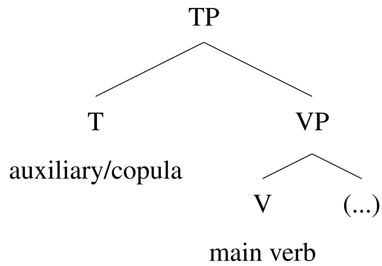
b. Missä Pekka on?
where.INE Pekka be.3SG.PRES
'Where is Pekka?'

In sum, there are two major distinctions in verb movement between Finnish and English. First, the main verb moves to T in Finnish but stays in Domain 1 (e.g. the Voice head) in English (apart from the copula). Second, the element occupying the T-head (verb or auxiliary) raises to C in all English questions, but stays in T in Finnish *wh*-questions. These differences between Finnish and English verb positions in the verbal extended projection are summarized in (203)–(204), using the placeholder “V” for the original location of the verb in Domain 1:

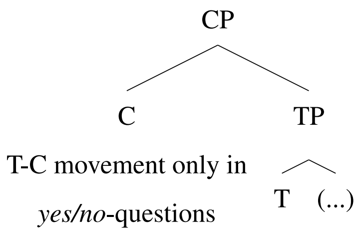
(203) a. Finnish:



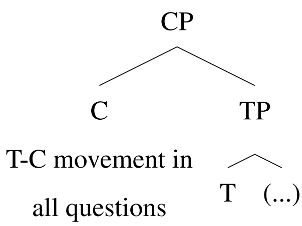
b. English:



(204) a. Finnish:



b. English:



In English, an auxiliary is added to T in negated clauses, passive clauses, and questions (again, with the exception of the copula, which raises to T). In Finnish, the corresponding T-position is filled by the verb raised from V. The resulting addition of an auxiliary accounts for 19.7% of Finnish-English unit shifts (AUX, COP-PASS). Furthermore, the different position of verbs between Finnish and English accounted for word-order shifts across multiple types (COP-PRON, ADV-V, COP-N, 33 AUX-PRON tokens, PRON-V, PRON-NEG, 1 NEG-PRON token), covering 19.7% of word-order shifts. Overall, differences in verb position accounted for 17.4% of all translation shifts.

6.5.3 Overt vs. covert P

All English Ps are stand-alone prepositions, whereas Finnish expresses similar meanings either via stand-alone pre-/postpositions or semantic case. Following Nikanne (1993), I treat Finnish semantic cases as assigned by a phonologically covert P. The contrast between Finnish and English PPs expressing an equivalent SEM ('in') is shown in (205), where the Finnish P is phonologically covert and assigns the inessive case to the complement DP, while the English P is overt and assigns the accusative case:

(205) a. Finnish:

```
     PP
    /  \
   P    DP
   ∅   [INE]
```

b. English:

```
     PP
    /  \
   P    DP
   in  [ACC]
```

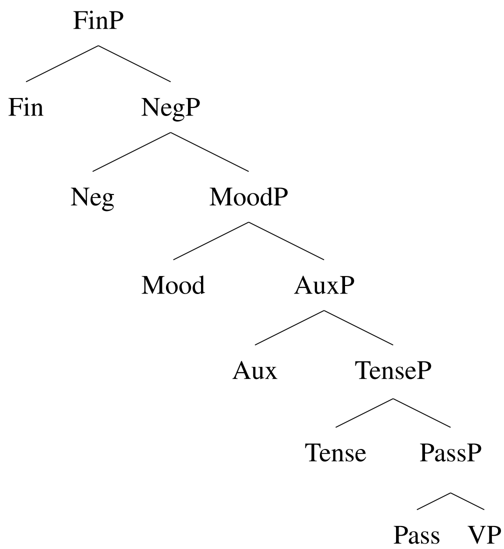
The difference between semantic case and overt adpositions thus concerns the availability of phonologically empty Ps and their case assignment properties. Adding English overt Ps in translating Finnish covert Ps accounts for 13.6% of Finnish-English unit shifts and 11.4% of all translation shifts.

6.5.4 Order of functional heads in the split TP

In addition to differing with respect to verb movement, the Finnish and English T-domains have distinct internal cartographies. The relevant difference for present purposes concerns the order between two functional heads, hosting *negation* and *auxiliary verbs*, respectively. Holmberg et al. (1993) proposed the maximal Finnish clause structure to be (206):[19]

[19]Holmberg et al.'s (1993) cartography for the Finnish T-domain has been refined further in subsequent work (e.g. Nikanne 2018), but (206) suffices here. I have made slight changes to their notation for the ease of readability. In the original paper, Fin was titled "F", Mood "TM" (for "Tense-Mood"), and Tense "T". I also only capitalize the first letter of each node while they used full capitalization.

(206)



Pass sets passive morphology,[20] Tense marks tense, Aux hosts the copula auxiliary in (plu)perfect verbs, Mood sets (e.g. conditional) mood, Neg hosts the negation, and Fin marks finiteness and sets subject-verb agreement. Holmberg et al. (1993) further introduce a number of head-movements across these heads. They consider Fin to host the verb in affirmed finite clauses and the negation in negated finite clauses. In the latter, the verb stays in Tense, where it has raised from V.[21] The copula auxiliary (used in perfect tense) originates in Aux but raises to Mood in negated clauses and to Fin in affirmed clauses. Spec,FinP is the grammatical subject position, to which the active clause subject or passive clause object moves. For illustration, (208) is Holmberg et al.'s analysis of the negated pluperfect finite clause *sinä et ollut ostanut sitä kirjaa* ('you had not bought that book'):

---

[20] If Pass is assimilated to Kratzer's (1996) Voice, it heads the verbal Domain 1 (see Chapter 4, Section 4.3.2). Hence, in the present framework it would not belong to the split TP – i.e. the verbal Domain 2.

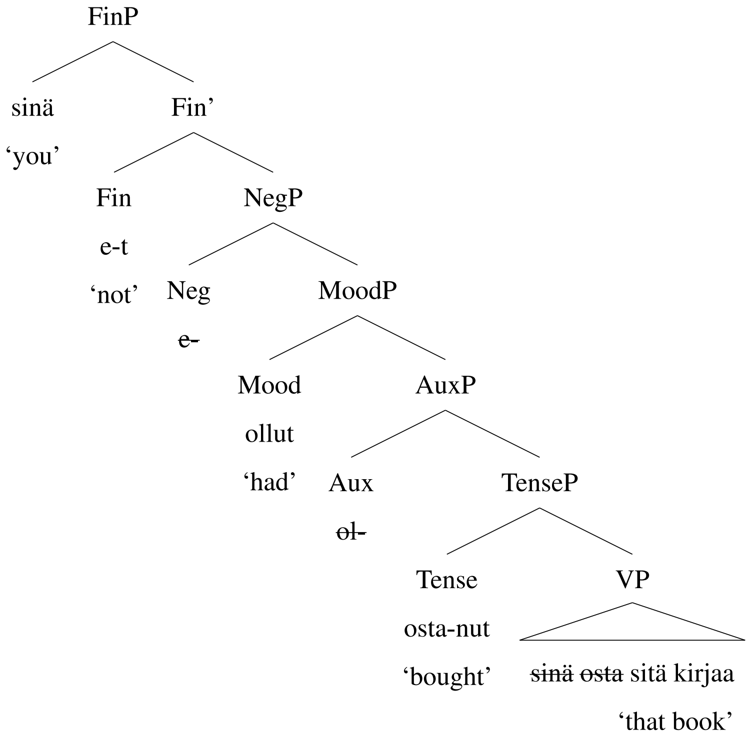
[21] Tense is separated from Fin because tense is also marked in Finnish non-finite participial clauses (see Section 6.5.18), as shown by the distinction between *ostaneen* (past) and *ostavan* (present/future) in (207):

(207) a. Hän kertoi Jussin **ostaneen** kirjan
3SG tell.3SG.PAST Jussi.GEN buy.PCP.PAST book.GEN
''(S)he told that Jussi has bought a book.'

b. Hän kertoi Jussin **ostavan** kirjan
3SG tell.3SG.PAST Jussi.GEN buy.PCP.PRES book.GEN
'(S)he told that Jussi would buy a book.'

(Holmberg et al. 1993: 191, my glosses and emphases)

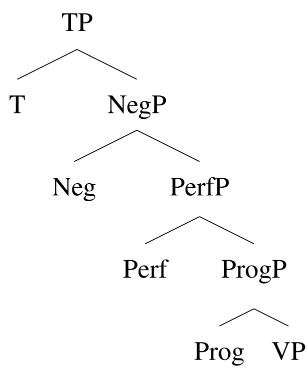
(208)



(based on Holmberg et al. 1993: 187)

Turning to the cartography of the English split TP, Adger (2003) proposes the four projections shown in (209), based on word and morpheme order:[22]

(209)

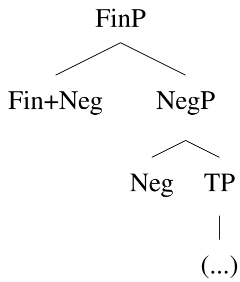


Prog sets progressive aspect with the copula auxiliary, Perf hosts the *have*-auxiliary used in (plu)perfect verbs, Neg introduces the negation, and T determines tense as well as hosts auxiliaries either base-generated there or raised from Perf.

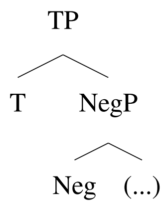
[22]English being the most widely discussed language in the generative literature, a comprehensive survey of the literature on the English T-domain would not be feasible in the present context. Instead, I use Adger (2003) as a representative source that illustrates the T-NEG order under present discussion.

The highest T-projection of (209) combines the functions of the Finnish Tense, Mood, and Fin heads of (206). Assuming that Neg raises to Fin (Holmberg et al. 1993: 184), the Finnish negation always appears in the highest functional position in (206). Consequently, English and Finnish differ with respect to the position of negation in the T-domain (i.e. the verbal Domain 2). A simplified illustration of this contrast is shown in (210), where "TP" is a placeholder for T-domain material comprising Tense and Mood functions.

(210) a. Finnish:



b. English:



English hosts modal auxiliaries in T, whereas in Finnish they reside below the negation and are inflected in tense. Adding the modal auxiliary *voi* ('can') to (208) results in (211), where it seems to occupy the Tense position:[23]

(211) Sinä et ollut voinut ostaa sitä kirjaa
2SG NEG.2SG have.PAST can.PAST buy that.PART book.PART
'You could not have bought that book'

The difference in modal auxiliaries was shown earlier in example (148), repeated as (212):

(212) a. i **could** never have imagined that something like this existed

b. en **olisi** **voinut** koskaan kuvitellakaan , että jotain
NEG.1SG be.3SG.COND can.PCP.PAST ever imagine-KIN that something
tällaista voisi olla
such.ELA could.COND be
'I could never have even imagined that something like this could exist'

[23]Since the modal auxiliary agrees with the subject if both the negation and perfect auxiliary are absent, it seems to raise to Fin when other heads do not block this. This is predicted by the *head-movement constraint* (Travis 1984), which can be treated as a consequence of *relativized minimality* (Rizzi 1990).

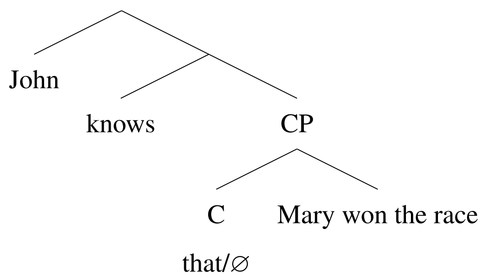
This is strictly speaking a word-order shift between the English *could have* and the Finnish *olisi voinut* (lit. 'have could'), but GIZA++ treated it as a unit shift by translating *could* to *olisi voinut*. It arises from the English modal auxiliary *could* residing higher in the split TP than its Finnish counterpart *voi(nut)*. Based on the discussion above, the English modal can be allocated to T on top of the TP, while the Finnish modal resides in the lower Tense projection.

A number of translation shifts could be explained by different positions of corresponding functional heads the Finnish and English split TP: 1.2% of Finnish-English unit shifts (COP-NEG), 40.6% of English-Finnish unit shifts (COP-NEG, most of NEG-V, AUX), and 27.6% of word-order shifts (AUX-NEG, 10 tokens of COP-NEG). Overall, 7.1% of all translation shifts could be traced back to this point of variation.

6.5.5 Covert complementizers

As discussed in Chapter 5 (Section 5.3.2) in relation to the translation universal of explication (e.g. Olohan and Baker 2000), English allows certain variants of the C-head to appear as phonologically empty when introducing an embedded clause or a relative clause. This was illustrated by example (86) there, as well as below in (213):

(213)



Finnish, in turn, requires complementizers to be overt, as shown in (214):[24]

(214) Pekka tietää (*että) Merja voitti kilpailun
Pekka know.3SG.PRES that Merja win.3SG.PAST race.GEN
'Pekka knows that Merja won a/the race'

Thus, while Finnish has covert Ps that English lacks (assigning semantic cases), English in turn has covert complementizers that are licensed in certain syntactic environments, whereas Finnish does not. Complementizer addition covered 13.4% of English-Finnish unit shifts and 1.6% of all translation shifts.

[24]The notation "(*että)" in (214) means that the complementizer *että* is mandatory, i.e. cannot be removed.

6.5.6 Mandatory determiners

English requires a determiner (or a possessor) in all noun phrases except indefinite plurals, mass nouns, and proper names. Finnish has no mandatory determiners, and allows nouns to be (at least phonologically) bare. Assuming the DP-hypothesis to apply at least to languages with mandatory determiners (Abney 1987, Brugè 2002),[25] there are three main ways to analyze the status of determiners in Finnish. The first approach is to treat Finnish as a "bare NP" language that lacks the D-projection, and allocate Finnish determiners to some other syntactic class than D. Another possibility is to assign Finnish with the full DP, and treat "bare" Finnish nouns as involving a phonologically covert D. The third option would accept the DP-analysis for overt determiners but treat noun phrases without overt determiners as lacking the D-projection.

At least for overt determiners, the DP-hypothesis has typically been adopted in generative work on Finnish (Holmberg and Plazack 1995, Manninen 2003a, Dal Pozzo 2007, Brattico 2008a,b, Huhmarniemi 2012, Saikkonen 2018).[26] If this is assumed, the lack of Finnish mandatory determiners can be analyzed as the optional status of the D-projection or the availability of a phonologically empty D. This is schematically shown in (215a), contrasted with the English mandatory D in (215b):[27]

(215) a. Finnish: (DP)

(D) NP

b. English: DP

D NP

Determiner addition in English accounted for 1.7% of Finnish-English unit shifts and 1.4% of all translation shifts.

[25] For general discussion of determiners, definiteness-marking and the DP-hypothesis across different languages, see e.g. Chierchia (1998), Lyons (1999) and Bošković (2008).

[26] In Gröndahl (2014) I defend the status of Finnish definite noun phrases as DPs. See also Norris (2018) on the DP in Estonian, which is closely related to Finnish.

[27] For notational convenience, I use "NP" as a generic term for D's complement, akin to "VP" used in Sections 6.5.1–6.5.2 and 6.5.4.

6.5.7 Aspect marking

Leiss (2007: 73) proposes that verbal aspect and nominal definiteness are two sides of the same grammatical function, and Finnish aspect marking corroborates this hypothesis. Finnish lacks a dedicated aspect morphemes in verb inflection, and instead marks aspect via the case of the direct object: genitive for perfective and partitive for imperfective aspect (Hakulinen et al. 2004: §1498). These cases are also used for definiteness marking in certain contexts (Chesterman 1991: 111). English, in turn, uses a copula auxiliary and verb inflection for marking imperfective aspect. The contrast is shown in (216)–(217):

(216) a. Merja maalasi taloa
Merja paint.3SG.PAST house.PART
'Merja was painting a/the house'

b. Merja maalasi talon
Merja paint.3SG.PAST house.GEN
'Merja painted a/the house'

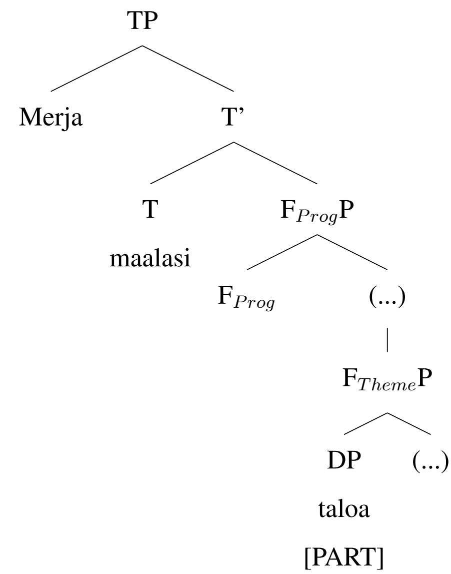
(217) a. Mary painted a house

b. Mary was painting a house

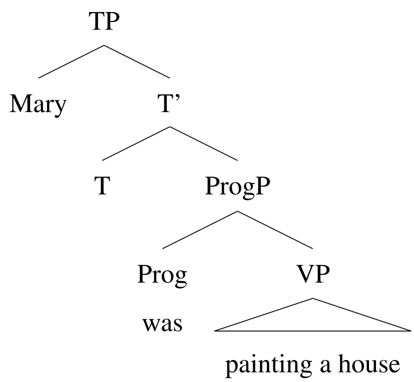
Following Adger (2003), the English imperfective (i.e. progressive) auxiliary can be allocated to the Prog projection that resides low in the T-domain (see Section 6.5.4). Finnish seems to lack its direct correlate, at least among phonologically overt functional heads. For present purposes, agnosticism can be maintained on where the partitive/genitive case for (im)perfectivity arises from in the Finnish direct object; plausible candidates being some functional heads in the extended VP (Domain 1) or TP (Domain 2). This is schematically shown in (218), where DP is the direct object and F_{Prog}P is a placeholder for some functional projection responsible for this case assignment in Finnish:[28]

[28]Another alternative would be that F_{Prog}=F_{Theme}; i.e. that the Theme-assigning functional head also determines aspect.

(218) a. Finnish:



b. English:



Analyzed in this manner, the distinction between Finnish and English in aspect marking comes close to the distinction between semantic case and overt prepositions, discussed in Section 6.5.3. In both cases, English has an overt functional head (P/Prog), while Finnish has a corresponding covert functional head (P/F_{prog}) that assigns case to a DP. Therefore, the addition of the copula auxiliary in English can be seen as a difference not so much in grammatical material as such, but in whether the phonological manifestation of functional material is based on its direct pronunciation or on indirect effects such as agreement or case in other elements. The addition of the progressive copula auxiliary in English accounted for 1.5% of Finnish-English unit shifts (COP-ING) and 1.3% of all translation shifts.

6.5.8 Linearization of adverbs

As discussed in Chapter 3 (Section 3.1.8), there are two main ways to account for variation in word-order within the present linguistic framework, assuming that the linearization algorithm resides at PF. This first is to assume a uniform linearization algorithm, and account for different word-orders via movement (Kayne 1994). The second is to allow different types of linearization for corresponding syntactic structures between different languages. The latter has been adopted in much of DM literature (Embick 2007, 2015, Embick and Noyer 1999, 2001, 2007, Arregi and Nevins 2012, Lohndal and Samuels 2013). I assume it here as well, leaving a possible movement-based analysis of the word-order variation covered below for future work.

In line with mainstream generative work on both English and Finnish (see Section 6.1), I assume the specifier-head-complement order for X'-structures, at least in the clause (see Section 6.5.9 for discussion of possible counter-examples in PPs). Despite the large range of available word-orders in the Finnish clause, these are systematically linked to different discourse functions such as topicalization or focus (Vilkuna 1989, Koskinen 1998, Huhmarniemi 2012). This indicates that the variation has a syntactic basis in movement.[29] In contrast, linearization is more variable among adjuncts, which illustrates possible PF-level variation.

With certain adverbs, English prefers placing them after the whole verb phrase, while Finnish prefers the pre-verbal position after the subject. This effect was also manifested with some PP adjuncts. An example translation with the adverb *anymore* – *enää* was given in example (161) from Section 6.4, repeated as (219):

(219) a. you can't do that anymore

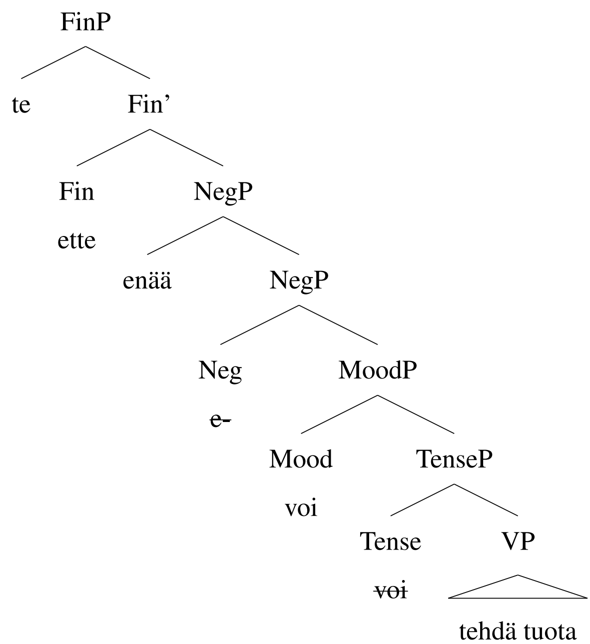
b. te ette enää voi tehdä tuota
2PL NEG.2PL anymore can do that
'You cannot do that anymore'

If the Finnish split TP is structured along the lines set out by Holmberg et al. (1993) (see Section 6.5.4), the position of *enää* in (219b) is somewhere between the highest T-domain head (Fin) and the verb. Assuming Neg to raise to Fin, the highest available position would thus be an adjunct of NegP, although a lower position is also possible. Since *anymore* in the English (219a) occurs after the VP in linear order, its syntactic position is difficult to assess. Here, I assume it is also an adjunct of NegP, but nothing hinges on this. As shown in (220),

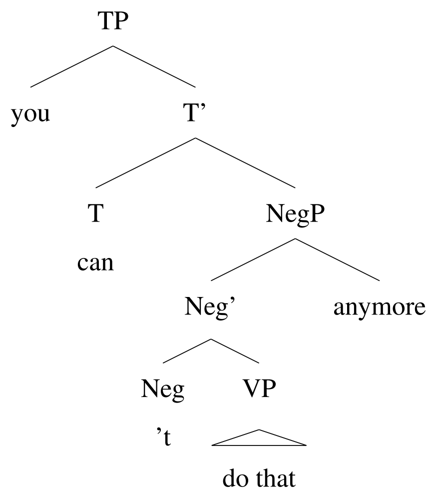
[29]For a detailed defence of the hierarchical nature of the Finnish clause despite the appearance of a "flat" structure due to word-order variation (*pace* e.g. Hakulinen and Karlsson 1979), see Koskinen (1998: 12–105).

the difference between Finnish and English now amounts to whether the adjunct is linearized to the left or right of the phrase it is adjoined to:

(220) a. Finnish:



b. English:



Word-order differences concerning verbs and their adjuncts accounted for 24% of word-order shifts (V-ADV, PRON-ADV, COP-ADV, V-N, ADJ-ADV, ADV-ADV, AUX-ADV, N-ADV, NUM-ADV), and 1% of all translation shifts.

6.5.9 Pre- vs. postposition

English only has prepositions, whereas Finnish has both prepositions (e.g. *ennen*, *ilman*) and postpositions (e.g. *kanssa*, *päin*) (Hakulinen et al. 2004: §687). Some adpositions also occur as both. Postpositions seem to be exceptions to the head-complement order manifested in Finnish: they are P-heads that succeed their complements in linear order. Another alternative would be that the complement raises to a higher position above P, as in (221):

(221)

DP PP

P ~~DP~~

Remaining agnostic about whether the pre-/postposition distinction arises due to linearization between P and its complement or via movement, I allocate this point of variation to linearization here for convenience. Word-order shifts traceable to the pre-/postposition distinction (P-N, P-PRON, P-CONJ, N-N) cover 22.2% of word-order shifts, and a minor English-Finnish unit shift (PRN-POSS: 17 tokens). Overall, they account for 1% of all translation shifts.

6.5.10 Negative determiners

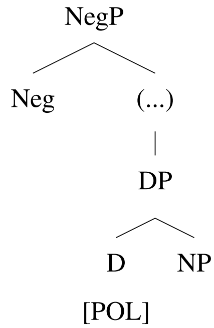
Finnish and English both have negation marking in the verb phrase (Section 6.5.4), but only English has an additional negative determiner in the noun phrase (*no*). Its closest Finnish correlates are determiners such as *yhtään* or *mitään*, which roughly translate to 'any'. As *negative polarity items*, they are only licensed in the scope of a clausal negation. The translation of the English determiner *no* to the Finnish clausal negation together with the determiner *mitään* was illustrated by the example translation (140)/(145) in Section 6.3.2. A simplified version of it (lacking the additional embedded clause) is shown below as (222):

(222) a. i have no idea

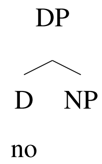
b. minulla ei ole mitään käsitystä
1SG.ADE NEG be.PRES any idea.PART
'I do not have any idea'

While both languages allow using the clausal negation with a polarity item, only English has a negative determiner. A schematic analysis of this difference is given in (223), where "[POL]" marks the status of a determiner as a polarity item:

(223) a. Finnish/English:



b. English:



The addition of the negative determiner in English accounted for 0.5% of Finnish-English unit shifts (NEG-N). In the other direction, the addition of the clausal negation in Finnish for an English source with the negative determiner accounted for 122 NEG-V unit shifts, and the addition of a polarity item determiner (*mitään*) covered 37 DET unit shifts, yielding 2.9% of English-Finnish unit shifts altogether. In word-order shifts, variation in negative determiners explains 17 COP-NEG shifts. Overall, these cover 0.8% of all translation shifts.

6.5.11 Question phrases

Finnish has the C-particle *-kO*[30] that can be used both for *yes*/*no*-questions with the verb raising to C, as well as with a noun phrase raised to Spec,CP akin to a *wh*-phrase (Huhmarniemi 2012, Holmberg 2014). These options are illustrated in (224):

(224) a. Syö-kö Pekka leipää?
eat.3SG.PRES-Q Pekka bread.PART
'Does Pekka eat bread?

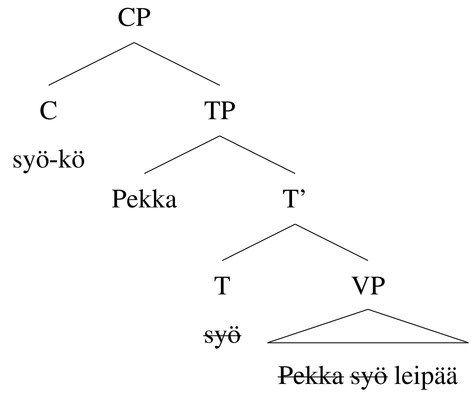
b. Pekka-ko syö leipää
Pekka-Q eat.3SG.PRES bread.PART
'Is it Pekka who eats bread?'

c. Leipää-kö Pekka syö
bread.PART-Q Pekka eat.3SG.PRES
'Is it bread that Pekka eats?'

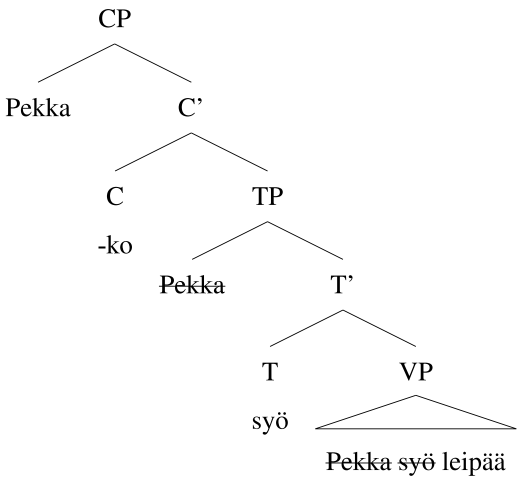
[30]The vowel of *-kO* manifests vowel harmony by being realized either as a front or back vowel depending on its phonological environment.

Syntactic analyses of (224a–c) are given in (225), again using "VP" as a placeholder for Domain 1 of the verbal extended projection:

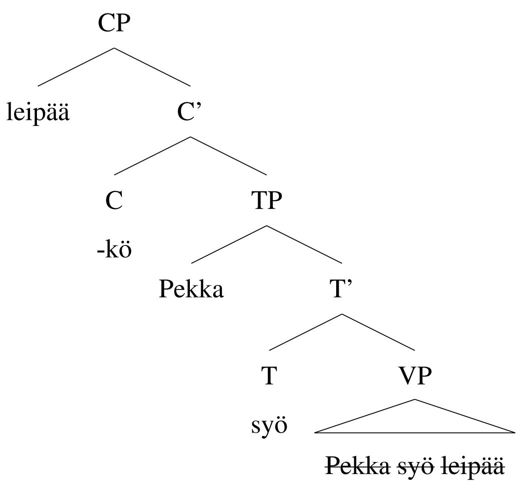
(225) a.



b.



c.



English lacks a particle similar to the Finnish *-kO*, and only allows raising *wh*-phrases to Spec,CP in questions. Hence, syntactic correlates of (224b–c) are absent in English. In addition, the range of *wh*-words available in Finnish is syntactically wider than the range available in English. For example, Finnish has a dedicated adjectival *wh*-word *millainen*, while English needs to use the complex paraphrase *what kind of* with the nominal *wh*-word *what*.[31] This is shown in (226):

(226) Millainen auto Merjalla on?
what.kind car Merja.ADE be.3SG.PRES
'What kind of a car does Merja have?'

In sum, Finnish is more lenient with respect to the kinds of elements that can appear in Spec,CP as question phrases: it allows the particle *-kO* to attach to any element that can be moved there; and it allows a wider range of possible *wh*-phrases than English. These differences account for 0.7% of Finnish-English unit shifts and 0.6% of all translation shifts.

6.5.12 Expletive subjects

While colloquial Finnish sometimes uses *se* as an optional expletive subject (Laury 1997, Holmberg and Nikanne 2002: 76), written Finnish does not mandate expletives in impersonal verbs whereas English does. This is illustrated in (227):

(227) a. (Se) sataa
EXPL rain.3SG.PRES
'It rains'

b. (*It) rains

Following standard generative theory, I analyze expletive insertion to be a consequence of the EPP-property that requires Spec,TP to be filled (Chomsky 1982). Thus, the variation concerns the status of the EPP in Finnish and English. The English EPP functions in a relatively simple manner: Spec,TP needs to be filled by the grammatical subject (raised from the VP), and an expletive is inserted when no element is available for raising. In transitive active sentences, only the Agent can occupy Spec,TP. Passive sentences lack this argument, so the Theme is raised instead. Hence, the highest available element in the VP is raised to Spec,TP

[31] The underlying syntactic structure of *millainen* could potentially be analyzed as combining the *wh*-marker *mi-* with the adjectival *-lainen* as a complement, bringing it closer to the English *what kind*.

(assuming the Agent to be above the Theme), and the expletive is merged as a last resort. These cases are shown in (228):

(228) a. She didn't see him

b. *Him didn't she see

c. He was seen

d. *Was seen him

e. (*It) rains

Finnish requires the movement of a subject, object, or adjunct to Spec,TP, which indicates the presence of the EPP at T (Holmberg and Nikanne 2002).[32] Since the Finnish verb raises to T (Section 6.5.2), leaving Spec,TP empty would result in the verb-subject-object order. This is indeed possible in Finnish, but it mandates a contrastive focus reading on the verb, which indicates that the verb has raised to C (Välimaa-Blum 1988, Vainikka 1989, Huhmarniemi 2012, 2019). As illustrated in (229), this word-order is compatible with the subject having raised to Spec,TP, and is thus not a counter-example to the EPP on T.

(229) [$_{CP}$ Syö [$_{TP}$ Pekka ~~syö~~ [$_{VP}$ ~~Pekka~~ ~~syö~~ leipää]]]
eat.3SG.PRES.FOC Pekka bread.PART
'Pekka does too eat bread!'

Furthermore, the verb-first order is not available in all constructions, such as (230a) with a partitive plural subject that does not trigger verb agreement. Here, Spec,TP needs to be filled with an expletive,[33] an argument, or an adjunct, as shown in (230b–d):

(230) a. *Leikkii lapsia kadulla
play.3SG.PRES child.PL.PART street.ADE
'Children are playing in the street'

b. Sitä leikkii lapsia kadulla
EXPL play.3SG.PRES child.PL.PART street.ADE
'There are children playing in the street'

[32] For simplicity, I use "T" here as a placeholder for the relevant T-domain head hosting the subject, such as Fin (see Section 6.5.4).

[33] The expletive pronoun in (230b) is *sitä*, which sounds identical to the partitive form of the third person singular non-human pronoun(/demonstrative) *se*. It is unclear how the partive case should be assigned. Holmberg and Nikanne (2002) argue that *sitä* is actually the case-neutral form of the expletive, which receives the nominative case (*se*) in certain contexts.

c. Lapsia leikkii kadulla
play.3SG.PRES child.PL.PART street.ADE
'Children are playing in the street'

d. Kadulla leikkii lapsia
play.3SG.PRES child.PL.PART street.ADE
'There are children playing in the street'

(Holmberg and Nikanne 2002: 75; my glosses)

The EPP in the Finnish TP is puzzling in light of cases like (227a), which show the possibility of clauses without an overt subject, despite the general unavailability of a third-person *pro* in Finnish (see Section 6.5.1). Various analyses exist in the prior literature (Vainikka 1989, Holmberg et al. 1993, Koskinen 1998, Vainikka and Levy 1999, Holmberg and Nikanne 2002, Brattico and Huhmarniemi 2006, Brattico 2016, Jokilehto 2017, Huhmarniemi 2019), of which I briefly summarize two here.

Holmberg and Nikanne (2002) propose that the EPP in the Finnish T is optional, but indirectly required for checking a [-Foc] feature on an argument/adjunct via movement. This feature states that the argument/adjunct in question expresses new information, and hence is not the *information focus* of the clause (Vallduvé and Engdahl 1996). Holmberg and Nikanne further assume that [-Foc] needs to be checked at Spec,TP, which in turn requires movement there. Such movement being driven by the EPP, it follows that the EPP can only be absent from T when no element with [-Foc] exists in the VP. Therefore, EPP is optional in principle, but indirectly required when some element with [-Foc] is present. The element with [+Foc] is not raised, resulting in elements with information focus being left below TP. When no [-Foc] element is present, the EPP – and hence the expletive – is optional, as in (227a).

Huhmarniemi (2019) criticizes Holmberg and Nikanne's (2002) account on the grounds that the subject can move to Spec,TP even when it bears [+Foc] and the object bears [-Foc], as in when the subject provides an answer to a prior *wh*-question (Dal Pozzo 2012).[34] Instead, she proposes an analysis that divorces movement to Spec,TP in Finnish from discourse-semantics in total. Here, the T contains an EPP-feature that is satisfied by the closest element in the VP,[35] which is usually the subject. The object can be raised above the subject in the VP, and

[34]Holmberg and Nikanne's (2002) analysis has further theoretical challenges as well: for instance, why does [-Foc] need to be checked at Spec,TP (as opposed to e.g. [+Foc]); and why is it possible for multiple elements with [-Foc] to appear in the VP when only one is checked at Spec,TP? I leave such considerations for future work.

[35]For simplicity, I have abstracted away from Huhmarniemi's analysis of the full VP as a vP-VP structure (Hale and Keyser 1993, Chomsky 1995a), where "v" corresponds to Kratzer's (1996) Voice head (see Chapter 4,

this (unlike the movement to Spec,TP) is driven by discourse semantics. When the object has raised in this way, it is the closest element that can raise to Spec,TP to fulfil the EPP. In other languages – such as English – similar VP-internal movement of the object does not take place, which disallows the EPP to be fulfilled by the object instead of the subject.

It is not clear what accounts for the optionality of the expletive in cases like (227a). In a prior presentation, Huhmarniemi (2017) proposes that the Finnish EPP is obligatory in Finnish finite clauses when the edge of VP is filled. This is rather puzzling: how could the optionality of EPP on T depend on whether the VP below it has an edge element? Furthermore, while Huhmarniemi accounts for the lack of object-movement to Spec,TP in English active sentences by the lack of VP-internal object-movement above the subject, this still does not explain why an adjunct can fulfil the EPP of T in Finnish but not in English. In general, further constraints on the variants of EPP between these two languages are still needed. One possibility would be to treat the EPP as a PF-based constraint (Holmberg 2000, Bobaljik 2002, van Craenenbroeck and den Dikken 2006, Landau 2007), which could allow its conditioning by the syntactic context more readily than its analysis as a lexical feature.

Leaving further discussion on the many complexities of the Finnish EPP for future work, for now it suffices that it diverges from its English counterpart in two main ways. First, it is optional in certain contexts, where the English counterpart requires an expletive subject. Second, it can be fulfilled by a range of elements (subject, object, adjunct), while English strictly requires the highest VP-internal thematic argument to raise to Spec,TP.

The English expletive subject was added to translations of null subject Finnish sentences in 91 Finnish-English unit shifts (EXP). Surprisingly, the Finnish expletive subject was also added in 36 English-Finnish unit shifts (EXP). These arose due to the English impersonal subject (*you*) lacking a Finnish correlate, which was replaced with the (usually optional) expletive subject (*sitä*). Furthermore, 15 word-order shifts (AUX-PRON) arose from the English sentence containing an expletive subject in Spec,TP, while in Finnish a PP adjunct (*tässä metsässä*: 'in this forest') had raised to Spec,TP above the syntactic position of its English translation.

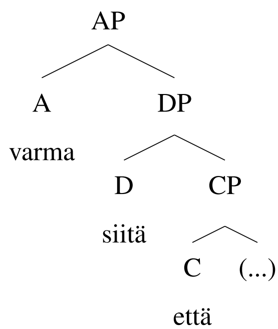
Section 4.3.2). In general, I have refrained from using this variant of "v" in any examples to avoid its conflation with the verbal categorizer in DM (see Chapter 3, Section 3.1.5). While early work in DM sometimes assimilated these two senses of "v" (Harley 1995, Marantz 1997), this is incompatible with the linguistic approach adopted in Chapters 3–4, where v is merged directly with the root while Voice is the highest functional head in the verbal Domain 1. For further arguments in favor of separating v from Voice, see e.g. Alexiadou et al. (2006), Pylkkänen (2008), and Harley (2013).

Overall, differences in expletive subjects – and hence the EPP in T – accounted for 0.3% of translation shifts.

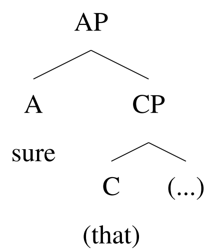
6.5.13 DP- vs. CP-argument

Some English verbs and adjectives allow CP arguments, while their closest Finnish translations take a DP argument. As a consequence, the Finnish translations use the pronoun *se* (‘it’) together with a CP complement. A syntactic analysis of the translation pair *varma siitä että* – *sure (that)* is given in (231).[36]

(231) a. Finnish:



b. English:



This variation might initially seem lexical, as it concerns argument selection. However, I treat it as syntactic since the addition of the pronoun in Finnish (*siitä*, i.e. *se* inflected in partitive case) is not part of the translation of the English source word as such, but only included for grammatical purposes. Hence, it does not satisfy the criterion for lexical unit shifts (discussed in Section 6.6). The addition of *se* in Finnish due to different selectional restrictions concerning the complements of translated words accounted for 1.7% of English-Finnish unit shifts (PRN-COMP) and 0.2% of all translation shifts.

[36] Like with “VP” and “NP’ in preceding sections, I use “AP” as a placeholder for the adjective phrase, not opening its syntactic structure further for the simplicity of notation.

6.5.14 Infinitive marking

English infinitives are marked by *to* in T, whereas the Finnish infinitive has no such particle. I assume that the Finnish infinitive contains a phonologically covert T, but other analyses would also be possible; what matters for present purposes is that there is no overt stand-alone particle corresponding to the English *to*.[37] This difference is summarized in (232):

(232) a. Finnish:

TP
T VP
∅ [INF]

b. English:

TP
T VP
to [INF]

Adding *to* in infinitive clauses accounted for 0.2% of Finnish-English unit shifts (rounded down) as well as 0.2% of all translation shifts (rounded up).

6.5.15 Covert relative pronouns

In addition to allowing a covert complementizer at C (see Section 6.5.5), English also uses optionally covert relative pronouns in certain syntactic contexts. Finnish, in contrast, requires relative pronouns to be overt. This difference is demonstrated in (233):

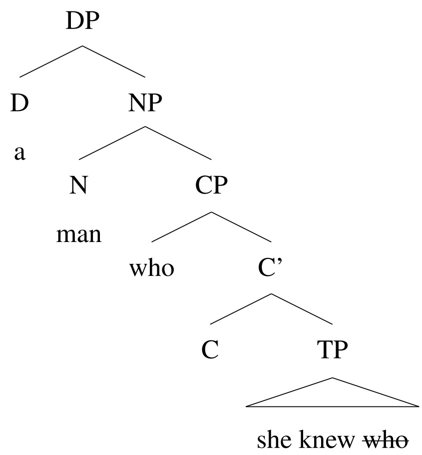
(233) a. Mary saw a man (who/that) she knew

b. Merja näki miehen (*jonka) hän tunsi
Merja see.3SG.PAST man.GEN who.GEN 3SG know.3SG.PAST
'Merja saw a man who she knew'

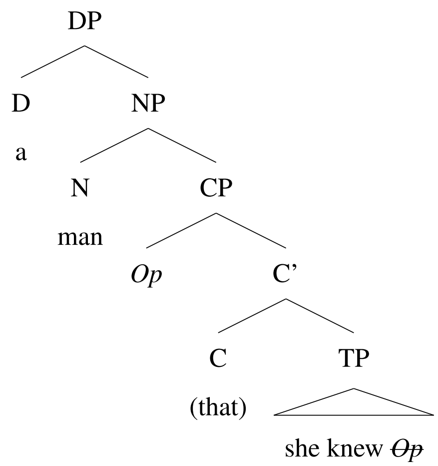
I adopt the view that even bare relative clauses contain a phonologically empty operator (*Op*) at Spec,CP, and that the English word *that* is not a relative pronoun but a complementizer head at C (Carnie 2013: 370). Assuming the relative clause to be a complement or adjunct of the noun (phrase), the different variants of the direct object in (233a) are shown in (234a–b):

[37] For discussion of the Finnish infinitive from a generative perspective, see Toivonen (1995) and Koskinen (1998).

(234) a.

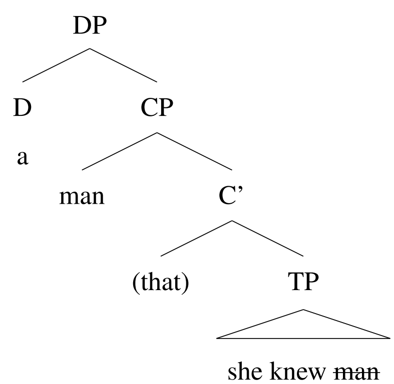


b.



An alternative analysis has been given by Kayne (1994), who proposes that non-*wh* relative clauses are DPs that take a CP complement, and the relative clause arises via CP-internal movements as shown in (235):

(235)

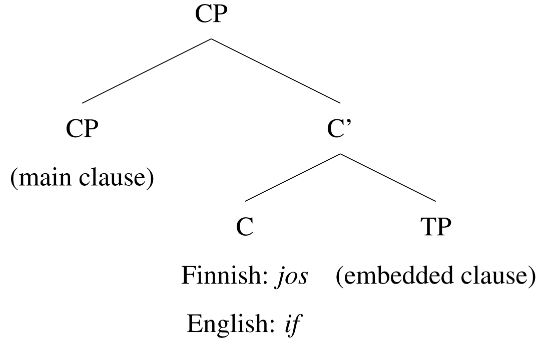


Kayne's alternative is a development of the *raising analysis* of relative clauses (Vergnaud 1974, Bianchi 2000), standing in opposition to the more traditional *matching analysis* illustrated in (234) (Chomsky 1965, Jackendoff 1977, Borsley 1997). Manninen (2003b) argues for the raising analysis for Finnish (restrictive) relative clauses, while Huhmarniemi and Brattico (2013) defend the matching analysis. I make no commitment concerning this debate, as the source of the observed unit shifts remains traceable to the same source in either case: the availability of empty relative pronouns or complementizers. English allows these in certain contexts, while Finnish does not. The addition of a relative pronoun covers 1% of English-Finnish unit shifts (REL) and 0.1% of all translation shifts.

6.5.16 Conditional clause position

Both Finnish and English allow a conditional clause to appear either before of after the main clause it modifies. Nevertheless, some variation was manifested between corresponding clauses across translations. This can be analyzed as both Finnish and English linearization algorithms specifying two possible orders between the conditional clause and the main clause, which allows the choice to be based on pragmatic considerations beyond grammar, such as fluency in discourse. The two options are illustrated schematically in (236), assuming that the conditional is a C-head:

(236) a.



b.

CP
C’ CP (main clause)
C: Finnish: *jos*, English: *if*
TP (embedded clause)

Alternatively, the order in (236b) could also arise via movement, akin to the analysis of postpositions given in (221) (Section 6.5.9). Further research is required to assess these options in more detail, as well as to explain what underlies the observed differences in order preference between Finnish and English, given that both languages allow both orders. Word-order shifts based on conditional clause position (CONN-V, CONN-AUX, CONN-PRON) accounted for 2.5% of word-order shifts and 0.1% of all translation shifts.

6.5.17 Degree adverbials

Both Finnish and English mark degree (comparative/superlative) in adjectives and adverbs. In Finnish, degree markers are always suffixes (*-mpi* for comparatives and *-(i)n* for superlatives). In English, adjectives/adverbs the PHONs of which have one syllable take degree suffixes (*-(e)r* for comparatives and *-(e)st* for superlatives), but with more syllables a stand-alone degree adverb is used instead (*more* for comparatives and *most* for superlatives).

I assume that degree is determined by a functional head in the extended adjective phrase (Corver 1997, Neeleman et al. 2004). Further typological evidence exists for hierarchically layered comparative and superlative heads (Bobaljik 2012), but I abstract away from this here and allocate the degree to a single functional head Deg. The difference between English and Finnish thus concerns whether Deg manifests via agreement in the adjective or as a stand-alone adverb, as shown in (237):

(237) a. Finnish:

DegP
Deg AP
[COMPARATIVE] -mpi
[SUPERLATIVE] -(i)n

b. English

(1 syllable):

DegP

Deg | AP
[COMPARATIVE] | -(e)r
[SUPERLATIVE] | -(e)st

c. English

($\geq$ 2 syllables):

DegP

Deg | AP
more
most

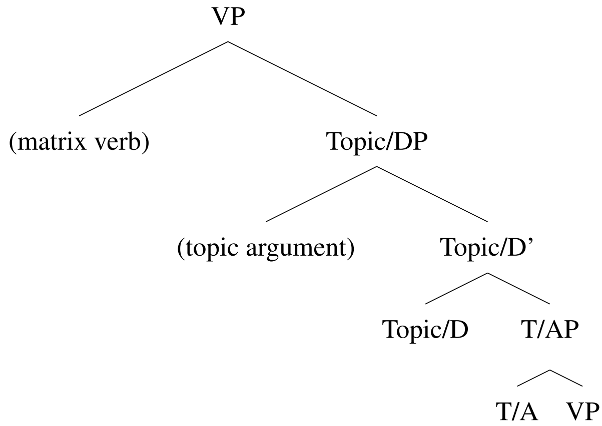
Adding *more*/*most* in English translations of comparative/superlative adjectives accounted for 39 Finnish-English unit shifts, which amounts to 0.1% of all translation shifts.

6.5.18 Participial clauses

As discussed in Chapter 5 (Section 5.3.4), Finnish uses participial constructions that lack direct syntactic correlates in English (Eskola 2004). Finnish participial constructions combine verbal and nominal properties in their syntactic behaviour. Like their verbal counterparts, they assign case and thematic roles to their objects, can be passivized, and inflect in tense. However, they resemble noun phrases in occurring as arguments of verbs, inflecting in case, and taking possessive suffixes. While Finnish participial constructions differ from genuine denominal verbs (Koskinen 1998: 118–126), generative analyses have generally treated them as combining a lower verbal portion with higher adjectival and/or nominal functional projections (Vainikka 1989, 1994, Koskinen 1998).

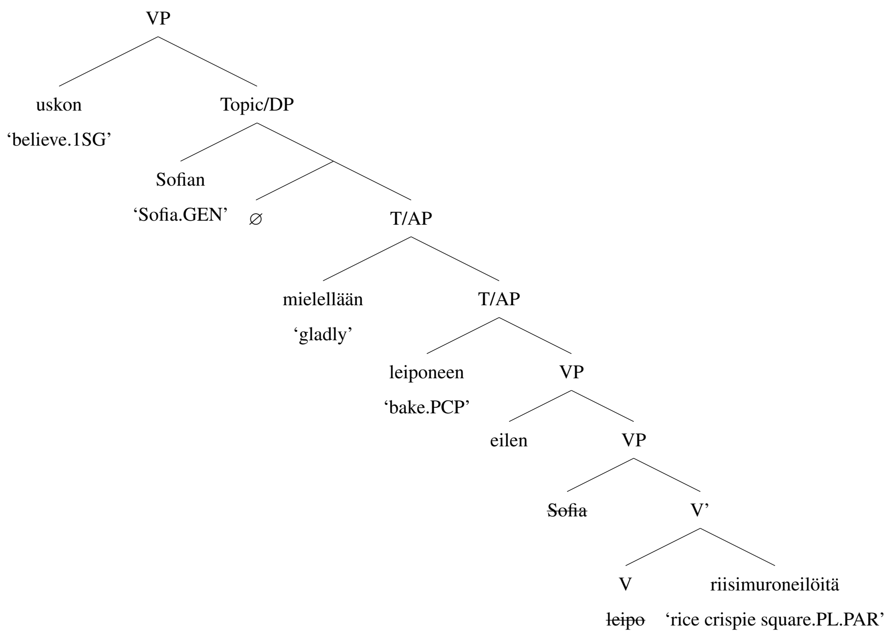
Koskinen (1998) proposes the structure (238) for Finnish embedded participial clauses, where T/AP is a projection that bears both adjectival and tense features, and Topic/DP is a nominal projection that hosts the topic argument in its specifier.

(238)



As an example, Koskinen's analysis of the sentence *uskon Sofian mielellään leiponeen eilen riisimuroneliöitä* ('I believe that Sofia gladly baked rice crispie squares yesterday') is given in (239):[38]

(239)



(modified from Koskinen 1998: 156)

I leave additional syntactic analysis of Finnish participial constructions for further work; what matters for present purposes is that they lack a direct syntactic correlate in English. Translating (239) to English would thus require using a finite embedded clause (*I believe*

[38]For simplicity, I abstract away from Koskinen's analysis of the full VP as a vP-VP structure (see Section 6.5.12, Footnote 35).

that Sofia gladly baked rice crispie squares yesterday) or an infinite clause (*I believe Sofia to have gladly baked rice crispie squares yesterday*). In the actually observed translation shifts, example (129) from Section 6.3.1 was explained by such a syntactic divergence, and is repeated below as (240) with the Finnish participial clause and the corresponding English finite embedded clause in square brackets:

(240) a. sitten nuorempi sisarus lähti matkaan [vanhemman
then young.COMP sister go.3SG.PAST trip.ILL old.COMP.GEN
jäädessä paikalleen]
stay.PCP.PRES place.ILL.3SG-POSS
'Then the younger sister begun to travel while the older one stayed in place'

b. then the younger sibling set off , [and the elder remained behind]

Translating a Finnish participial clause to an English finite clause resulted in the addition of a connective (*and*) between it and the main clause in 12 unit shifts (CNN) in the Finnish-English direction ($< 0.1\%$ of translation shifts).

6.5.19 Focusing

Finnish allows focusing an element by raising it to the left of the clause. This operation is available for subjects, objects, and adjuncts, shown in (241) with capitalization marking focus:

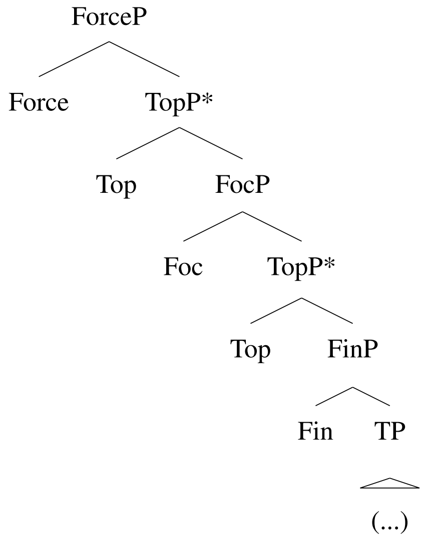
(241) a. Pekka luki eilen kirjan
Pekka read.3SG.PAST yesterday book.GEN
'Pekka read a/the book yesterday'

b. PEKKA luki eilen kirjan
Pekka.FOC read.3SG.PAST yesterday book.GEN
'It was Pekka who read a/the book yesterday'

c. KIRJAN Pekka luki eilen
book.GEN.FOC Pekka read.3SG.PAST yesterday
'It was the book that Pekka read yesterday'

d. EILEN Pekka luki kirjan
yesterday.FOC book.GEN Pekka read.3SG.PAST
'It was yesterday that Pekka read a/the book'

I assume that the Finnish C-domain contains a Focus head in its C-domain (Kenesei 1992, Koskinen 1998, Huhmarniemi 2012). Rizzi (1997) proposed such a Focus projection as a linguistic universal in his influential split CP analysis shown in (242):

(242) 

Without taking a stance on the universality of FocP, it seems to be available in English as well, illustrated by the fronting of the object in (243a) and the adverb in (243b):

(243) a. THE BOOK John read yesterday (not the magazine)

b. YESTERDAY John read the book (not today)

Nevertheless, focusing via movement to the Focus projection was more prominent in Finnish than English in the translation data. Since focusing is not grammatically mandatory in either language, this exemplifies stylistic variation. It covered 11 V-PRON word-order shifts ($< 0.1\%$ of translation shifts).

6.5.20 Summary

Sections 6.5.1–6.5.19 have identified 19 syntactic points of variation between Finnish and English, summarized in Table 6.8. While not an exhaustive list of all the ways in which these languages differ, they suffice to cover the translation shifts discussed in Sections 6.3–6.4, when appended with lexical and orthographic shifts. I further divide them into five high-level classes: (i) the presence/order of functional heads, (ii) morphological marking, (iii) movement/EPP, (iv) linearization, and (v) selectional constraints. Variation of each kind can be explained within the linguistic framework of Chapter 3, and is compatible with allocating language differentiation to PF as maintained there. I briefly summarize the high-level classes and their syntactic basis below.

Class	Locus of variation		Finnish	English
Presence/order of functional heads	Order of functional heads in the split TP		Neg > Tense	Tense > Neg
	Mandatory determiners		No	Yes
	Negative determiners		No	Yes
	Participial clauses		Yes	No
Morphological marking	Pro-drop		1.–2.-person subject/possessor	No
	Overt vs. covert P		Both (covert: semantic case)	Overt
	Covert complementizers		No	Yes
	Aspect marking		Object case	Copula + verb inflection
	Infinitive marking		Verb inflection	Marker in T (*to*) + verb inflection
	Covert relative pronouns		No	Yes
	Degree marking		Inflection	Inflection, degree adverbs
Movement/ EPP	Verb movement	V-T	Yes	No (except for the copula)
		T-C	All questions	*Yes*/*no*-questions
	Mandatory expletive subjects		No	Yes
	Question phrases		Generic question particle (*-ko*)	Only *wh*-phrases
	Focusing		Yes; more common	Yes; less common
Linearization	Pre- vs. postpositions		Both	Prepositions
	Linearization of certain types of adverbs		Left	Right
	Linearization of conditional clauses		Both; left more prominent	Both; right more prominent
Selectional constraints	DP- vs. CP-argument selection		Both; DP more common	Both; CP more common

Table 6.8: Summary of the syntactic basis of Finnish-English translation shifts.

Presence/order of functional heads. Two languages differ in this respect when some functional head can be present in one but not the other (relative to some syntactic context), or when the respective orders of corresponding heads differs in the relevant extended projections. Of the points of variation listed in Table 6.8, the presence (or order) of functional heads covers at least four: *order of functional heads in the split TP*, *mandatory determiners*, *negative determiners*, and *participial clauses*. In addition, some of the other classes may also involve differences in functional heads and/or features. First, if the covert *pro* is treated as a separate pronoun from its overt counterparts, then variation in *pro-drop* concerns functional material. Second, *aspect marking* may involve differences in functional structure in addition to morphological marking (object case vs. verb inflection). Finally, the broader availability of *question phrases* in Finnish is due to the *-ko* particle lacking an English equivalent.

As argued in Chapter 3 (Section 3.3.4), variation in the presence of functional heads can be allocated to the availability of Vocabulary Insertion rules that target those functional heads. These reside at PF. Hence, even though the variation manifests as the linguistic division of functional material in the Lexicon, it can be accounted for without assuming the language-specificity of either the Lexicon or NS.

Morphological marking. Finnish relies heavily on agreement and case for indicating the presence of a functional head, while English typically marks functional heads with stand-alone morphemes. I also count the availability of phonologically empty functional heads into this class. Variation in morphological marking accounts for seven points of variation: *pro-drop*, *adpositions vs. semantic case*, *covert complementizers*, *aspect marking*, *infinitive marking*, *covert relative pronouns*, and *degree marking*. (As discussed above, some of these may involve variation in functional material as well.)

Agreement and case can either be analyzed via the Agree relation triggered by uninterpretable features, or allocated to PF (see Chapter 3, Section 3.2.3). In the former case, variation concerning them is allocable to the same source as variation in the presence of functional features in general: which features are targeted by language-specific PF-rules. Hence, both types of analyses are in line with locating the source of their variation to PF.

Movement/EPP. Finnish and English differ both in terms of phrasal movement and head-movement. Finnish moves the verb to T while English does not (with the exception of the copula). T moves to C across all English questions, but only *wh*-questions manifest this movement in Finnish. Both Finnish and English TPs have an EPP feature, but their differences result in variation with respect to expletive subjects and certain word-order shifts. In the C-domain, Finnish allows moving elements more freely in questions (via the *-ko* particle), while English questions only allow a *wh*-phrase to occupy Spec,CP. Finally, even though both languages have a Focus projection in the CP, Finnish is more prone to focus elements via movement.

Phrasal movement is driven either by the EPP or some interface-requirement, such as the SEM-rule of a functional head making reference to its specifier.[39] In the latter case, variation concerning movement would be an indirect consequence of the relevant functional head's presence in the language (see the discussion above). If the EPP is a lexical feature, its variation would also fall to the general class of which features are targeted by language-specific VIs. Alternatively, the EPP could be analyzed as an interface constraint at PF, in which case the movement at NS would take place to fulfil it. With respect to head-movement, I assume it is either a PF-phenomenon or explainable via similar processes as phrasal movement. Overall, variation concerning movement can, at least indirectly, be motivated by PF-variation even when the movement itself takes place in NS.

Linearization. Finnish and English differ in three ways that can be located to the linearization of corresponding syntactic structures. First, Finnish uses both pre- and postpositions, while English only uses prepositions. Second, certain adverbs tend to be linearized either

[39] For example, Cinque and Rizzi (2010) suggest that the Topic head activates the instruction "my specifier is to be interpreted as the topic" (p. 51). If so, the specifier must exist for this interpretation to be applied. Similar considerations also apply to the exoskeletal approach to argument structure, where the SEMs of argument-introducing functional heads make reference to their specifiers (Chapter 4, Section 4.3.2).

pre-verbally (in negated clauses) or between the verb and the object (in affirmed clauses) in Finnish, whereas in English the equivalent adverbs occur at the right end of the clause. Finally, while both languages allow linearizing conditional clauses either before of after the main clause, the left side was more prominent in Finnish than in English. As discussed in Section 6.5.8, I adopt a PF-account of linearization which allows it to vary across languages. Another option would be to assume a constant linearization algorithm such as Kayne's (1994) LCA, in which case seeming variation in linear order would be accounted for by movement (as discussed above).

Selectional constraints. Certain translated words have different selectional constraints with respect to their arguments. For example, the Finnish adjective *varma* takes a DP argument while its Finnish translation *sure* requires a CP (or PP) argument. Selectional constraints can either be analyzed as consequences of functional structure (e.g. argument-introducing heads like F_{Theme}; see Chapter 4, Section 4.3.2), or alternatively as root-specific constraints on interface-interpretations (i.e. SEMs or PHONs). In the first case, variation concerns functional structure, as discussed above. In the latter, it concerns the interface-interpretation of roots, the presence of which can be indirectly language-specific by virtue of the VIs that target them, akin to functional heads.

In sum, the 19 syntactic points of variation are allocable to five higher-level classes, all of which can be analyzed within the linguistic framework of Chapters 3–4, and are compatible with the allocation of language differentiation (within a bilingual I-language) to PF. The syntactic classes cover 84.9% of translation shifts in the Tatoeba corpus.

6.6 Lexical translation shifts

A lexical shift arises when a single source language word is translated to multiple target language words, each of which contributes to the translation itself instead of being added for grammatical reasons. As an example, *liikaa* $\rightarrow$ *too much* is a lexical shift, since *too* and *much* jointly contribute to the translation of the source word. In contrast, the syntactic shifts covered in Section 6.5 arise due to grammatical requirements even when there is a 1–1 translation between lexical roots. For instance, *sataa* $\rightarrow$ *it rains* is not a lexical shift, as the two target words have clearly distinct grammatical functions, one being directly related to translating the source word and the other to satisfying the EPP (Section 6.5.12).

In Chapter 5 (Section 5.1.1), the existence of translation mismatches was discussed as evidence against a strong form of linguistic universalism. The lexical translation shifts covered here illustrate that certain lexical roots in Finnish lack a single-root translation in English, or vice versa. Given that the SEMs of roots and complex phrases are determined differently in the present framework (Chapter 4, Sections 4.3.1–4.3.2), the results indicate that Finnish and English SEMs are not fully overlapping. This further illustrates the need for analyzing translation without the requirement of SEM-identity.

Lexical shifts may arise for multiple reasons, but all involve some deviation from compositional translation. As a first approximation, the target domain lacks a concept that would be the SEM of some target expression with a 1–1 syntactic correspondence with the source expression. Section 6.7 returns to this analysis in more detail. Lexical translation shifts also have general relevance to the status of *construction-specific* information in language processing. As discussed in Section 6.7.7, the present results suggest a modest but non-negligible role for such information.

All lexical unit shifts from the Tatoeba data are collected in Table 6.9 in a descending order based on token count. In addition, I manually lemmatized each shift, classified them based on the part-of-speech of the source, and added schematic elements that would be needed for the translation to be used. For example, the translation *parasta→'d better* only works when the Finnish source appears as the complement of the copula (typically in the conditional mood): *olisi parasta* (lit. 'would be better'). These manually post-processed lexical shifts are given in Tables 6.10–6.11. Sections 6.6.1–6.6.2 review salient properties of lexical shifts in both translation directions.

Finnish-English			
source	**target (count)**	**source**	**target (count)**
minulla	i have (476)	osaa	knows how (15)
sinulla	you have (370)	varmasti	must be (15)
minusta	i think (172)	syttyi	broke out (15)
liikaa	too much (120)	anteeksi	pardon me (15)
minulla	i 'm (112)	sammuttaa	turn off (15)
meillä	we have (106)	heräsin	i woke up (14)
minulla	i 've (100)	syödään	let 's eat (14)
mieli	feel like (90)	mukaan	with me (14)
anteeksi	i 'm sorry (74)	hauskaa	good time (14)
ollenkaan	at all (70)	palata	go back (14)
anteeksi	excuse me (62)	yhteistä	in common (14)
kiitos	thank you (61)	ottakaa	help yourself (14)
mennään	let 's go (52)	mitäköhän	i wonder what (14)
vaikka	even though (48)	enää	any longer (13)
ainoa	only one (46)	heti	right away (13)
yhtään	at all (45)	nykyään	these days (13)
yli	more than (42)	ottakaa	please help yourself (13)
lainkaan	at all (38)	sujuvaa	fluent in (13)
heti	as soon (38)	toivotaan	let 's hope (13)
nähdään	see you (38)	haluttaa	feel like (13)
rakastunut	in love with (33)	sinulla	are you (12)
tapahtuu	going on (31)	yksin	by myself (12)
heti	at once (30)	tahallaan	on purpose (12)
huvita	feel like (30)	jotkut	some people (12)
pelkään	i 'm afraid (29)	varo	be careful (12)
meillä	we 've (28)	toisemme	each other (12)
aluksi	at first (28)	lapsesta	since i was kid (12)
paremmin	better off (27)	lapsesta	since i was child (12)
sinulla	you 've (26)	varmistaa	make sure (12)
toisiamme	each other (26)	minulla	i had (11)
pihta	fir tree (26)	myöhässä	being late (11)
ainakin	at least (25)	yhteyttä	get in touch with (11)
osaa	know how (24)	tehdään	let 's do (11)
sinusta	you think (24)	vihdoinkin	at last (11)
sinulla	you 're (23)	herätä	wake up (11)
pitkään	long time (23)	rakastunut	in love (11)
mielestäni	i think (23)	tietääkseni	as far as know (11)
olisipa	i wish (23)	istuutui	sat down (11)
meillä	we 're (23)	rakastui	fell in love with (11)
toisiaan	each other (23)	riisui	took off (11)
ota	help yourself (22)	mulla	i 'm (10)
nukahti	fell asleep (22)	näin	this way (10)
vaikka	even if (21)	minulla	i don (10)
siksi	that 's why (20)	näin	like this (10)
päivittäin	every day (20)	yksin	by himself (10)
varaa	can afford (19)	pelkää	is afraid of (10)
turhaan	in vain (19)	tapahtumaan	going happen (10)
toisilleen	each other (19)	kauan	long time (10)
kaukana	far away (18)	saisinko	please give me (10)
ota	please help yourself (18)	pystyä	be able (10)
parasta	'd better (18)	myös	as well (10)
puhumattakaan	not mention (18)	etukäteen	in advance (10)
toimeen	get along (18)	ilmastointi	air conditioner (10)
tuolla	over there (18)	välittömästi	at once (10)
vähintään	at least (18)	häivy	get out (10)
minulla	i am (17)	loppui	ran out of (10)
pelkää	is afraid (17)	tietenkin	of course (10)
voinut	couldn help (17)	nähdään	i 'll see you (10)
mennään	let 's (17)	kiinnostaa	is interested in (10)
palaan	i 'll be back (16)	järkeä	make sense (10)
innolla	looking forward (16)	ylihuomenna	day after tomorrow (10)
kolmesti	three times (16)	typeryyksiä	stupid things (10)
sellaista	such thing (15)	toisianne	each other (10)
kunnossa	all right (15)	yhteenlaskua	two fractions together (10)

English-Finnish			
source	**target (count)**	**source**	**target (count)**
never	ei koskaan (236)	owe	olen velkaa (10)
before	ennen kuin (168)	red-handed	kiinni housut kintuissa (10)
tonight	tänä iltana (88)	talk	puhua kanssasi (10)
never	ei ikinä (62)	another	vielä yksi (10)
nothing	ei ole mitään (54)	work	teen töitä (10)
work	tehdä töitä (52)	someday	jonain päivänä (10)
wish	voi kunpa (44)	anything	mikä tahansa (10)
actually	itse asiassa (36)	wherever	mihin ikinä (10)
as	niin kuin (36)	until	ennen kuin (10)
anything	mitä tahansa (36)	working	tekee töitä (10)
feel	tekee mieli (36)	whatever	mitä tahansa (10)
never	en koskaan (33)		
recently	viime aikoina (32)		
years	vuoden ajan (31)		
agree	samaa mieltä (30)		
feel	tee mieli (29)		
nothing	ei mitään (26)		
used	oli tapana (25)		
most	suurin osa (24)		
twice	kaksi kertaa (24)		
lately	viime aikoina (23)		
please	ole hyvä ja (23)		
until	kuin vasta (22)		
nothing	mikään ei ole (21)		
please	ole hyvä (21)		
think	sitä mieltä (20)		
off	pois päältä (20)		
apologize	pyytää anteeksi (19)		
red-handed	kiinni rysän päältä (19)		
never	älä koskaan (19)		
nothing	mikään ei (19)		
please	ole kiltti ja (19)		
never	en ikinä (18)		
ask	kysyä sinulta (18)		
feel	tunnen oloni (18)		
afford	ole varaa (17)		
equal	yhtä suuri kuin (16)		
nothing	mitään ei (16)		
owe	olet velkaa (15)		
red-handed	kiinni itse teossa (15)		
long	pitkäksi aikaa (15)		
feel	tunnen itseni (15)		
instead	sen sijaan (14)		
tonight	tänä yönä (14)		
getting	alkaa tulla (14)		
never	eivät koskaan (14)		
miss	on ikävä (14)		
hurry	pidä kiirettä (14)		
while	sillä aikaa kun (13)		
feel	minua haluttaa (13)		
used	oli ennen (13)		
rid	päästä eroon (12)		
equals	on yhtä suuri kuin (12)		
cooking	laittaa ruokaa (12)		
anyway	joka tapauksessa (11)		
busy	kova kiire (11)		
equals	on yhtäsuuri kuin (11)		
bloom	täydessä kukassa (11)		
please	olkaa hyvä ja (11)		
marry	mennä naimisiin (11)		
while	kun taas (11)		
while	silloin kun (11)		
exist	ole olemassa (11)		
forgive	anna anteeksi (11)		

Table 6.9: Lexical unit shifts (minimum token count 10).

6.6.1 Finnish-English

There were 3866 lexical Finnish-English unit shifts across 128 types. Most involved the addition of function words such as pronouns (*anteeksi* → *excuse* ***me***, *mielestäni* → ***i*** *think*), prepositions (*yhtään* → ***at*** *all*, *tapahtuu* → *going* ***on***) or auxiliary verbs (*varaa* → ***can*** *afford*, *parasta* → ***'d*** *better*). As shown in Table 6.10, I further divide the lexical shifts into six classes based on part-of-speech: *adjectives/adverbs* (35 types), *verbs* (21 types), *nouns* (6 types), *interjections* (4 types), *pronouns/anaphora* (2 types), and *complementizers* (2 types).

In addition, I include a category for *constructions*, containing 38 types. In contrast to the other categories, it consists of those translations that are specific to the syntactic context and/or a particular inflection. As an example, the most common lexical shift was *minulla* → *i have*, which arises due to the lack of a direct Finnish lexical correlate to the English verb *have*. Instead, a similar meaning is expressed by inflecting the possessor argument in the adessive case, roughly corresponding to the interpretation 'in my possession'. This was illustrated by example (103) in Section 6.3.1, repeated below as (244):

(244) a. **minulla** on vähän rahaa
1SG.ADE be.3G.PRES little money.PART
'I have a little money'

b. **i have** a little money

This shift instantiates a more abstract Finnish-English construction shift of the form 'X.ADE olla Y'→ 'X have Y', where X and Y are elements with corresponding translations.

As another illustration of the construction category, a present tense passive verb is used in (colloquial) Finnish to express a first person plural imperative – i.e. a verb V in the form V.PASS.PRES means 'we should V'. English lacks a first person plural imperative inflection for verbs, and instead uses the construction *let's V*, which uses the second person imperative (*let*) and the first person plural indirect object (*us*) to achieve the interpretation. I allocate this shift to the construction class since it only concerns Finnish verbs with a specific inflection. For comparison, other shifts (such as *nukahtaa* → *fall asleep*) can be instantiated in any of the inflections that the source word allows, and are therefore classified based on the part-of-speech of the source word (verb in *nukahtaa*) rather than as members of the construction class.

While I do not analyze each of the 128 lexical shift types in syntactic detail, I raise a few observations from Table 6.10 that are plausibly related to the syntactic shifts discussed in Section 6.5. First, the largest part-of-speech class was *adverb*, and here the most prominent

Verbs	
syntyä	be born
rakastua	fall in love with
tapahtua	(be) going on
huvittaa	feel like
pelätä	be afraid
pelätä	be afraid of
osata	know how
nukahtaa	fall asleep
palata	be back
palata	go back
sammuttaa	turn off
syttyä	break out
herätä	wake up
haluttaa	feel like
varmistaa	make sure
varoa	be careful
riisua	take off
istuutua	sit down
loppua	run out of
häipyä	get out
pystyä	be able

Nouns	
ainoa	only one
pihta	fir tree
ajanhukka	waste of time
sellainen	such thing
typeryys	stupid thing
ilmastointi	air conditioner

Pronouns/anaphora	
toisensa	each other
jotkut	some people

Interjections	
anteeksi	I'm sorry
anteeksi	excuse me
anteeksi	pardon me
kiitos	thank you

Adjectives/adverbs	
liikaa	too much
ollenkaan	at all
yhtään	at all
lainkaan	at all
yli	more than
heti	as soon (as)
heti	at once
heti	right away
rakastunut	in love with
rakastunut	in love
aluksi	at first
paremmin	better off
ainakin	at least
pitkään	(for a) long time
turhaan	in vain
vähintään	at least
NUM:sti	NUM times
kunnossa	all right
kaukana	far away
tuolla	over there
nykyään	these days
mukaan	with me
enää	any longer
tahallaan	on purpose
yksin	by myself
yksin	by himself
vihdoinkin	at last
ylihuomenna	day after tomorrow
tietenkin	of course
välittömästi	at once
etukäteen	in advance
myös	as well
kauan	(for a) long time
näin	like this
näin	this way

Complementizers	
vaikka	even though
vaikka	even if

Constructions	
X.ADE (olla Y)	X have (Y)
X.ADE (olla Y)	X be (Y)
X.ADE (ei ole Y)	X don't (have/be Y)
V.PASS.PRES	let's V
X.ELA	X think
mielestäni	I think
(tehdä) mieli	feel like
nähdään	see you
nähdään	I 'll see you
(menestyä) paremmin	(be) better off
olisipa	I wish
ota/ottakaa (X)	help yourself (to X)
ota/ottakaa (X)	please help yourself (to X)
päivittäin	every day
siksi	that's why
(olla) varaa	can afford
(tulla) toimeen	get along
puhumattakaan	not (to) mention
(ei) voinut	couldn't help
(olisi) parasta	'd better
(tehdä) mielummin (X)	'd rather (do X)
(odottaa) innolla	look forward
(X on) varmasti (Y)	(X) must be (Y)
mitäköhän	I wonder what
(olla X) yhteistä	(have X) in common
(tulla X) mukaan	(come) with X
(pitää) hauskaa	(have a) good time
(puhua) sujuvaa (X.PART)	(be) fluent in (X)
X.ELA (asti)	since I was X
ensisilmäyksellä	at first sight
(ottaa) yhteyttä	get in touch with
(olla) myöhässä	be late
tietääkseni	as far as (I) know
(olla) järkeä	make sense
(X) kiinnostaa	be interested in (X)
(tulla) tapahtumaan	(be) going (to) happen
saisinko (X.GEN/PART)	please give me (X)
(laskea) yhteenlaskua	(add) together

Table 6.10: Lemmatized lexical/phrasal Finnish-English translations (material in parentheses added by me).

shift involved the addition of a preposition (as in *yhtään* → *at all* or *tahallaan* → *on purpose*). Given the independently motivated analysis of Finnish semantic case as involving covert Ps (Nikanne 1993; see Section 6.5.3), it is plausible that at least some of these adverbs might include covert Ps as well.

Second, many verb shifts added the copula (as in *pelätä* → *be afraid* or *palata* → *be back*) or another "light" verb with little if any independent lexical meaning, such as *go* (e.g. *palata* → *go back*) or *get* (e.g. *häipyä* → *get out*). In DM, light verbs can be analyzed as v-categorizers without a root complement (Marantz 1997). Hence, this difference between Finnish and English could be analyzable as English using more morphologically independent variants of v than Finnish, which strongly prefers incorporating the root to v.

Verbs	
work	tehdä töitä
feel (like)	tehdä mieli
feel	tuntea itsensä
feel	tuntea olonsa
feel	haluttaa
afford	olla varaa
agree	(olla) samaa mieltä
use (to)	olla tapana
use (to)	oli ennen
think	(olla) sitä mieltä (että)
ask	kysyä sinulta
apologize	pyytää anteeksi
owe	olla velkaa
hurry	pitää kiirettä
miss	olla ikävä
equal	(olla) yhtä suuri kuin
cook	laittaa ruokaa
bloom	(olla) täydessä kukassa
forgive	antaa anteeksi
exist	olla olemassa
work	tehdä töitä
talk	puhua kanssasi
couldn	(ei) olisi voinut
marry	mennä naimisiin

Determiners	
most	suurin osa
another	vielä yksi

Pronouns/anaphora	
nothing	ei mitään
nothing	ei mikään
anything	mitä tahansa
anything	mikä tahansa
whatever	mitä tahansa

Complementizers	
before	ennen kuin
until	kuin vasta
until	ennen kuin
while	sillä aikaa kun
while	silloin kun
while	kun taas

Constructions	
(I) wish	voi kunpa
(for NUM) years	(NUM) vuoden ajan
as (X)	niin kuin (X)
please (V)	ole/olkaa hyvä ja (V)
please (V)	ole/olkaa kiltti ja (V)
please	ole hyvä
(get caught) red-handed	(jäädä) kiinni rysän päältä
(get caught) red-handed	(jäädä) kiinni itse teossa
(get caught) red-handed	(jäädä) kiinni housut kintuissa
getting	alkaa tulla
(get) rid (of)	päästä eroon
(be) busy	(olla) kova kiire
(for) long	pitäksi aikaa

Adverbs	
never	ei koskaan
never	ei ikinä
tonight	tänä iltana
tonight	tänä yönä
actually	itse asiassa
recently	viime aikoina
twice	kaksi kertaa
lately	viime aikoina
off	pois päältä
instead	sen sijaan
anyway	joka tapauksessa
someday	jonain päivänä
wherever	mihin ikinä

Table 6.11: Lemmatized lexical/phrasal English-Finnish translations (material in parentheses added by me).

Finally, despite the lexical status of these translation shifts, most added material in English was functional rather than lexical. In DM-terms, translation of a single-root source to a multi-root target was rare. This indicates that, even when English lacks a 1–1 translation of a Finnish root, it there is still a preference for using target expressions with only a single root. One possible explanation of this is the higher memory requirements of searching for target roots, given their open-ended range in comparison to the closed class of functional heads.

6.6.2 English-Finnish

In the English-Finnish direction, there were 1889 lexical unit shifts across 75 types. Common additions included negations (*never* $\rightarrow$ ***ei koskaan***, *nothing* $\rightarrow$ ***ei*** *mitään*) and copula verbs (*please* $\rightarrow$ ***ole*** *hyvä*, *afford* $\rightarrow$ ***ole*** *varaa*). Manually lemmatized lexical shifts (together with additional material for constructions) are shown in Table 6.11, made of eight classes: *verb* (24 types), *adverb* (13 types), *construction* (13 types), *complementizer* (6 types), *pronoun/anaphora* (5 types), and *determiner* (2 types). All classes are smaller than in the Finnish-English direction, and especially constructions are significantly fewer in kind.

Like in the Finnish-English direction, the addition of the copula verb was typical in verb shifts, as in *owe* → *olla velkaa* (lie. 'be in debt') or *exist* → *olla olemassa* (lit. 'be existent'). In contrast, other "light" verbs are less prominent in Finnish. Construction shifts were commonly highly idiomatic, such as three translations of the English *get caught red-handed*. Compared to the Finnish-English direction, there were more shifts where the target contained multiple lexical words. These included *agree* → *olla samaa mieltä* (lit. 'be of the same mind'), *feel* → *tunnen oloni* (lit. 'I feel my condition'), and *work* → *tehdä töitä* (lit. 'do work').

6.7 Pipeline for Finnish–English translation

This section constructs a theoretically grounded pipeline for analyzing Finnish–English translations in either direction. Its purpose is to make testable predictions about the target expression's syntactic structure based on the source expression's syntactic structure. Section 6.7.1 describes the general pipeline in a language-neutral way, and Sections 6.7.2–6.7.6 apply it to Finnish-English translation with respect to different types of SOs. Section 6.7.7 discusses the relation between the pipeline and the translation shifts covered in Sections 6.5–6.6.

6.7.1 General pipeline

Based on the framework developed in Chapter 5, the translation of a source expression X to a target expression Y in language L can be re-analyzed as (245):[40]

(245) SEM(X) immediately entails SEM(Y) in the domain of L.

The domain of language L is the set of SEMs that can be expressed in L. According to the account of bilingualism developed in Chapter 3 (Section 3.3.3), this is ultimately determined by which SOs are targeted by the PF-rules of L – i.e. the relevant maximal group of mutually compatible PF-rules. The purpose of the translation pipeline is to open (245) further based on syntactic structures that X and Y can have, in a way that yields concrete hypotheses testable via translation data (such as parallel corpora).

[40] As discussed in Chapter 5 (Section 5.2.2), immediate entailment can further be confined to a *discourse*, which allows cases where the target is not strictly entailed by the source alone. While this is a non-negligible component of actual translation performance, I abstract away from it here since the general pipeline (*qua* general) does not make reference to any particular discourse.

Chapter 4 proposed the SEM-taxonomy (246) for different types of syntactic heads:

(246)
- **Roots (+ categorizers):** <M>
- **Domain 1 functional heads:** <M> or <D>
- **Domain 2 functional heads:** <M, M>
- **Domain 3 functional heads:** link to another representation

In addition, principle (247) applies across Domains 1–2:

(247) The SEMs of complex phrases are of type <M>.

The realization of (247) via the atomic SEMs in (246) is achieved via a few basic modes of combination. Complex Domain 1 SEMs are formed via M-junction or D-junction, both of which result in conjunctive SEMs of type <M> via the assimilation of free variables between conjoined SEMs. In Domain 2, predicate modifiers turn monadic predicates into others (possibly in non-conjunctive ways). Finally, the SEMs of some Domain 3 heads allow treatment via D-junction, while others require further operations.[41]

At the center of the pipeline is what I call the *Merge-Translation Principle (MTP)*, defined in (248):

(248) **The Merge-Translation Principle (MTP):**
Merge(X_1, X_2) translates to Merge(Y_1, Y_2) in L if:
a. X_1 translates to Y_1 in L
b. X_2 translates to Y_2 in L

Chapter 5 (Section 5.2.3) showed that if A_1 immediately entails B_1 and A_2 immediately entails B_2, then $A_1 \wedge A_2$ immediately entails $B_1 \wedge B_2$ unless this is explicitly blocked by an additional inference. That is, the *default* immediate entailment of a conjunctive concept is the conjunction of the immediate entailments of its constituent concepts. The principle that conjunction can ground translation in this way allows the *productive* translation of arbitrary expressions with conjunctive SEMs, which extends to conjunctions between concepts that have not been previously conjoined. Syntactic Merge corresponds to conjunction in M-junction and D-junction, which yields adherence to the MTP in Domain 1.

[41] As discussed in Chapter 4 (Section 4.3.2), many other complications are also left out, including intensional contexts (Soames 1988, Larson and Ludlow 1993, Pietroski 2000) and non-subsective adjuncts (Kamp and Partee 1995, Pavlick and Callison-Burch 2016). My cautious prognosis is that the translation pipeline could also be valid across these, but its proper theoretical grounding needs to be left for future work.

Since SEMs in Domains 2–3 can be non-conjunctive, the MTP cannot be proven in the same way there as in Domain 1. Instead, I propose the *empirical hypothesis* that the MTP also applies across Domains 2–3. This hypothesis makes concrete testable predictions: the translation of a complex source SO headed by a Domain 2–3 head should contain the translation of this head's complement. A plausible theoretical basis for this hypothesis would be that even non-conjunctive complex SEMs are *strongly compositional*, structurally containing their constituents (Fodor and Mclaughlin 1990, Fodor and Lepore 2001, Pagin 2003).

In addition to the MTP, the pipeline is based around four assumptions concerning the translation of syntactic heads: roots are translated to roots, categorizers to categorizers, functional heads to functional heads, and any source to a target with the same SEM-type. Of these, the last is the most crucial, and the rest follow from additional considerations of the SEM-types available for different SOs. In particular, *concepts* in the sense discussed in Chapter 4 (Section 4.2.2) are typically linked to (categorized) roots, while functional heads modify these with additional information that is more restricted in scope.

In sum, the pipeline builds on the five principles laid out below, where X is a SO and TR(X) is its translation:

- If X is a root, then TR(X) is a root.
- If X is a categorizer (n, v, a), then TR(X)=X.[42]
- If X is a functional head, then TR(X) is a functional head.
- If SEM(X) is of type Θ, then SEM(TR(X)) is of type Θ.
- If X = Merge(X_1, X_2), then TR(X) = Merge(TR(X_1), Merge(TR(X_2)).

These principles do not directly constrain syntactic domains. Instead, domain restrictions arise indirectly via the available SEM-types. Functional heads with <M>-SEMs are confined to Domain 1, which grounds their translation to Domain 1 heads. Similarly, since only Domain 2 contains predicate modifiers of type <M, M>, their translations are also confined to Domain 2. In contrast, since functional heads with the SEM-type <D> are distributed between Domains 1 and 3, their translation is indeterminate with respect to the domain.

[42] Here, I assume that the source and target language share the same categorizers. This is not strictly required: for example, languages vary in Gender systems (Corbett 1991), and Gender has been allocated to the n-categorizer in DM (Kramer 2015). Hence, the types of n-categorizers might differ across languages. In this case, the principle should be formulated more liberally as only maintaining that a categorizer is translated to some (possibly non-identical) SEM-compatible categorizer. I gloss over this detail form now on.

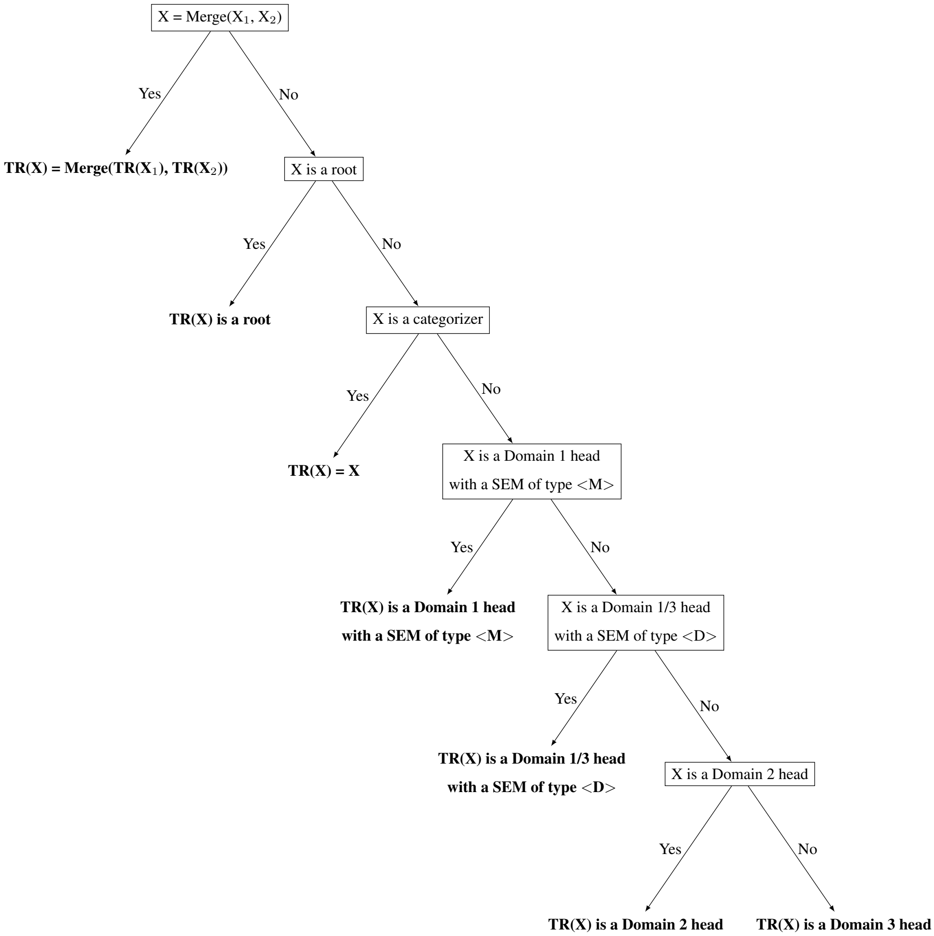


Figure 6.1: Generic translation pipeline.

The generic pipeline is presented in Figure 6.1, where each boxed node contains a query, and final nodes (in bold) are predictions about TR(X) based on how the query is answered. With two exceptions, all queries only concern the SO rather than SEMs. This is made possible by the syntax-semantics interface links that support inferences about SEMs via SOs alone. The exceptions arise from the fact that both Domain 1 and 3 can host multiple types of SEMs: either <M> or <D> in Domain 1, and either <D> or another type of linking operation (e.g. Force) in Domain 3 (see Sections 6.7.3 and 6.7.5).

Before beginning the concrete analysis of Finnish-English translation, two aspects of the pipeline should be clarified. First, it does *not* aim to model how a translator *produces* the target. Instead, it concerns relations between the source and target SOs. While these relations are ultimately grounded in cognitive architecture, they are not causal accounts of translation performance (see Chapter 2, Section 2.1). Second, the predictions made by the pipeline are *fallible*. They concern how an expression would be translated *unless* something blocked this. Their theoretically privileged nature stems from their default status, which also secures their productivity. From a cognitive perspective, exceptions are based on some additional information that overrides the default prediction (see Sections 6.7.6–6.7.7).

6.7.2 Roots and categorizers

In the present framework, categorized roots are the closest syntactic correlates of traditional lexical heads (Chapter 3, Section 3.1.5). As discussed in Chapter 4 (Section 4.3.1), the SEMs of categorizers are related to ontological classes such as event/state or object/mass, but the relation is complex. For example, verbs cannot denote objects while nouns can denote events. Leaving the further scrutiny of categorizer-SEMs for future work, here I simply adopt the hypothesis that roots must be categorized to receive SEMs (Aquaviva and Panagiotidis 2012, Aquaviva 2014a,b,c, Panagiotidis 2015). Furthermore, assuming that the same categorizers are available in both Finnish and English, roots and their translations are expected to be categorized in the same way by default.

The SEMs of roots are concepts, analyzed as pointers (i.e. conceptual addresses) to conceptual memory locations in Chapter 4 (Section 4.2.2). These contrast with the SEMs of functional heads, which provide further specifications or operations on such concepts. Hence, the default concept immediately entailed by a root-SEM is also expected to be a root-SEM. Sometimes this prediction is not borne out, as illustrated by lexical unit shifts reviewed in Section 6.6. Nevertheless, as covered in Chapter 5 (Section 5.3.1), a robust word-to-word preference has been observed in translated texts. As argued there, I reanalyze this finding as SEM-to-SEM preference. Since the typical SO linked to an atomic concept is a root, this indirectly grounds the prevalence of root-to-root translation.

Given the atomicity of root-SEMs, the translation pipeline cannot explain them based on compositionality. However, the discussion above allows making the prediction that roots tend to be translated to roots and categorizers to themselves. Consequently, if $\sqrt{1}$ is a root categorized as c, its translation is a root $\sqrt{2}$ categorized as c.

Root-to-root translations between Finnish and English are easy to find. A verbal, nominal, and adjectival variant are shown in (249a–c), with Finnish on the left English on the right:

(249) a. $[_{\mathrm{vP}}\ \mathrm{v}\ \sqrt{nukkua}\,]$ $[_{\mathrm{vP}}\ \mathrm{v}\ \sqrt{sleep}\,]$

b. $[_{\mathrm{nP}}\ \mathrm{n}\ \sqrt{koira}\,]$ $[_{\mathrm{nP}}\ \mathrm{n}\ \sqrt{dog}\,]$

c. $[_{\mathrm{aP}}\ \mathrm{a}\ \sqrt{punainen}\,]$ $[_{\mathrm{aP}}\ \mathrm{a}\ \sqrt{red}\,]$

Since the morphological realization of roots is systematically connected to phonological and orthographic words in both Finnish and English, the hypothesis makes the concrete prediction of $1-1$ translation as the default case across traditional "lexical categories".

6.7.3 Domain 1: M-junction and D-junction

Moving on to complex SEMs, the paradigm case in the conjunctivist framework is the conjunction of two constituent SEMs (Chapter 4, Section 4.3.2). In Chapter 5 (Section 5.2.3) it was further shown that if A_1 immediately entails B_1 and A_2 immediately entails B_2, then $\mathrm{A}_1 \wedge \mathrm{A}_2$ immediately entails $\mathrm{B}_1 \wedge \mathrm{B}_2$ unless this is explicitly blocked by an additional inference. This principle was presented in (83), repeated below as (250):

(250) For concepts $\{\mathrm{A}_1, \mathrm{A}_2, \mathrm{B}_1, \mathrm{B}_2\}$ and a domain δ: if

a. A_1 immediately entails B_1 in δ

b. A_2 immediately entails B_2 in δ

c. $\neg\exists \mathrm{X} \in \delta$ such that:

   i. $\mathrm{A}_1 \wedge \mathrm{A}_2 \Rightarrow \mathrm{X}$

   ii. $\mathrm{X} \Rightarrow \mathrm{B}_1 \wedge \mathrm{B}_2$

   iii. $\mathrm{B}_1 \wedge \mathrm{B}_2 \not\Rightarrow \mathrm{X}$

then $\mathrm{A}_1 \wedge \mathrm{A}_2$ immediately entails $\mathrm{B}_1 \wedge \mathrm{B}_2$ in δ.

That is, the default immediate entailment of a conjunctive concept is the conjunction of the immediate entailments of its constituent concepts. Evaluating (250c) relies on explicitly memorized information in the conceptual system that is not derivable from the conjunction $\mathrm{A}_1 \wedge \mathrm{A}_2$ alone. Therefore, the default assumption for an *arbitrary* conjunction is that (250c) is valid; i.e. that no "intervening" target candidate is present. This allows the *productive* translation of arbitrary expressions with conjunctive SEMs, even across conjunctions between concepts that have never before been conjoined.

In *M-junction*, syntactic Merge corresponds to the conjunction of two monadic SEMs interpreted as applying over the same free variable. Together with principle (250), this grounds the MTP for M-junction: TR(Merge(X_1, X_2)) = Merge(TR(X_1), TR(X_2)). This is illustrated in (subsective) adjunction, as exemplified in (251):[43]

(251) a. paljonko tämä **punainen hattu** maksaa ?
much-Q this red hat cost.3SG.PRES
'How much does this red hat cost?'

b. how much for this **red hat** ?

In (251), the adjective-noun complex *punainen hattu* is translated to *red hat*, which accords with the MTP in light of the translations *punainen–red* and *hattu–hat*. The respective syntactic structures are shown in (252), where the aP is an adjunct of the nP:

(252)

nP		nP	
aP	nP	aP	nP
punainen	hattu	red	hat

The neo-Davidsonian approach to verb SEMs analyzes them as monadic predicates over event variables (Chapter 4, Section 4.3.2). This allows treating adverbs similarly to adjectives in terms of M-junction. An example is given in (253):

(253) a. tom **juoksee nopeasti**
tom run.3SG.PRES fast
'Tom runs fast.'

b. tom **runs fast**

The adverb-verb phrases of (253) structurally correspond to the adjective-noun phrases of (252), as shown in (254):[44]

[43] Example translations in Sections 6.7.3–6.7.6 appear in the Tatoeba corpus. When appropriate, I highlight parts that are relevant for the SOs under discussion.

[44] The post-verbal linear position of the adverb in (252) arises from movement of the verb to Voice (and subsequently to T in Finnish). I abstract away from this movement for notational simplicity.

(254)

vP: [advP nopeasti] [vP juosta]

vP: [advP fast] [vP run]

Beyond adjunction, M-junction is also applies to Domain 1 functional heads that have monadic SEMs (dyadic SEMs requiring D-junction; see below). As an example, if the variables predicated over are assumed to be *plural variables* (Boolos 1984), the SEMs of number markers in noun phrases can be analyzed as monadic predicates that specify information about cardinality (Schein 1993, Pietroski 2003, 2018). For illustration, if the SEM of a plural marker is PLURAL – a monadic predicate specifying that a plural variable has more than one value – then the plural variants of the Finnish noun *koira* and its English translation *dog* are achieved via M-junction from the SOs shown in (255):

(255)

NumP: [Num [PL] -t] [nP koira]

NumP: [Num [PL] -s] [nP dog]

The MTP can be applied *recursively*, as the output of M-junction is of the same type as its inputs (<M>). An example of this is provided by the complex noun phrases in (256a–b), which contain both a plural marker and an adjunct:

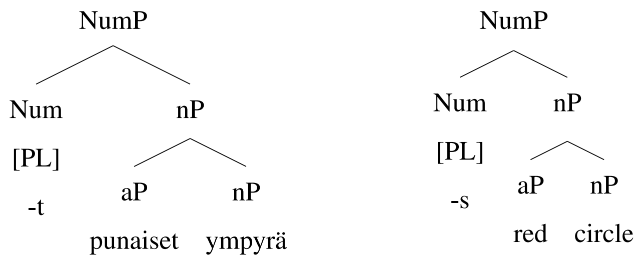
(256) a. kartalla olevat **punaiset ympyrät** esittävät
map.ILL be.3PL.PCP.PRES red.PL circle.PL portray.3PL.PRES
kouluja
school.PL.GEN
'Red circles on the map portray schools'

b. **red circles** on the map mark schools

Syntactic analyses of the respective noun phrases in (256a–b) are given in (257):[45]

[45]Finnish has number concord in adjectives, which is why *punainen* appears in the plural form (*punaiset*) in (257). I make no assumptions about the syntactic assignment of concord here (but see e.g. Baker 2008).

(257)



In interpreting both NumPs of (257), M-junction is first applied to the adjunction between nP and aP, which results in a complex conjunctive SEM of type <M>. Then, M-junction is applied to this SEM and the number marker, which again results in a complex SEM of type <M>. The type remains the same, since the free variable positions in each atomic SEM are assimilated in M-junction. Due to this recursivity, the MTP covers all complex phrases constituted by SOs that have SEMs of type <M>. In the linguistic framework adopted here, these are located to the syntactic Domain 1.

In *D-junction*, a functional projection introduces a dyadic relation applied over two variables (Pietroski 2018). In Domain 1, the most prominent applications of D-junction involve functional heads that introduce thematic arguments in their specifiers: Voice and F_{Theme} (Lohndal 2014). Translation obtains between two D-junction-inducing functional heads if immediate entailment obtains between the relations they introduce.[46] AGENT is triggered by Voice in both Finnish and English.[47] This accounts for translation between basic intransitive sentences such as (258a–b), the respective VoicePs of which are shown in (259):

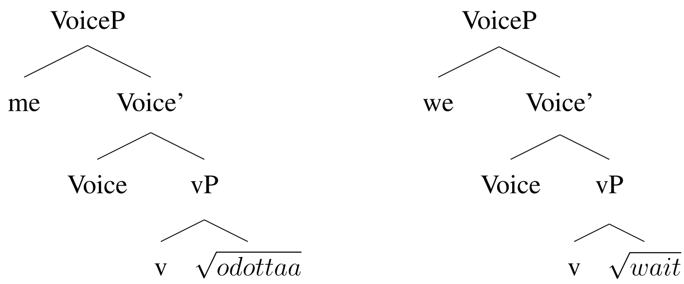
(258) a. me odotimme
1PL wait.3PL.PAST
'We waited'

b. we waited

[46]Relation R_1 entails relation R_2 if applying R_1 to any arguments licences applying R_2 to the same arguments. This allows a a straight-forward generalization of immediate entailment to polyadic relations.

[47]The possibility that thematic roles might differ between languages is not ruled out in principle. For example, different variants of Voice could account for the distinction between THEME and PATIENT (Jackendoff 1987, Van Valin 1999). The possibility of their inter-lingual variation should also not be discarded *a priori*. That notwithstanding, I am aware of no semantic basis for distinguishing the AGENT or THEME roles between Finnish and English, and I assume their identity (or at least equivalence) here.

(259)

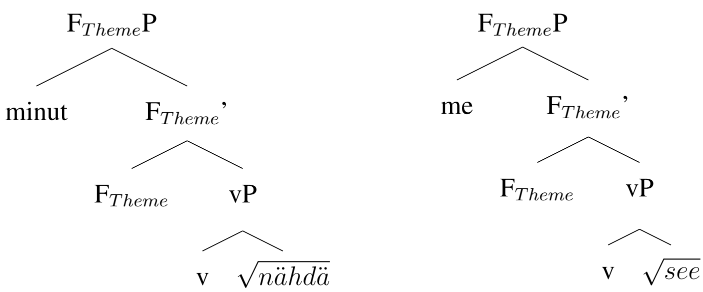


The same principle generalizes to F_{Theme}, which triggers THEME in both languages. This covers transitive clauses like (260), whose F_{Theme}Ps are shown in (259):

(260) a. tom **näki** **minut**
tom see.3SG.PAST 1SG.ACC
'Tom saw me'

b. tom **saw me**

(261)



Like M-junction, D-junction is recursive: both its two inputs and its output are of the type <M>. Consequently, Voice can be applied to F_{Theme}P as well as vP alone.

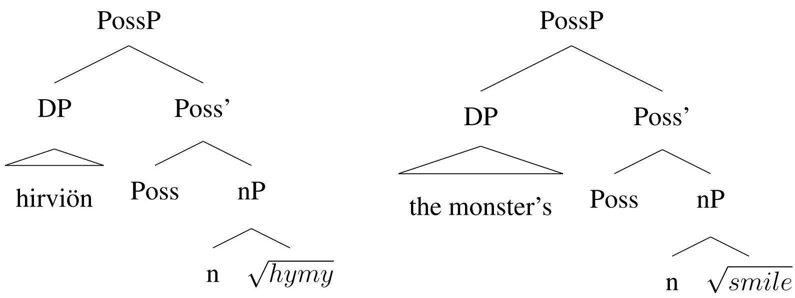
D-junction can also take place in noun phrases, prevalently as *possessor* addition (Szabolcsi 1994, Borer 2005a), exemplified in (262):

(262) a. **hirviön** **hymy** oli julma
monster.GEN smile be.3SG.PAST cruel
'A/the monster's smile was cruel'

b. **the monster's smile** was cruel

Just as AGENT and THEME link an event to a thematic argument, POSSESSOR links two entities based on the possession relation. Using the term "PossP" for the possessor-introducing functional head (Szabolcsi 1994, Tasseva-Kurktchieva 2004, Haegeman and Danckaert 2013), the respective noun phrases of (262) are shown in (263):[48]

[48]Treating PossP as a low nominal projection initially departs from the observation that English possessors

(263) 

In sum, both M-junction and D-junction are covered by the MTP: the translation of a complex phrase is based on the translations of its syntactic constituents. This secures compositional translation at the syntactic Domain 1.

6.7.4 Domain 2: predicate modifiers

Chapter 4 (Section 4.3.3) argued that the SEMs of functional heads in Domain 2 are *predicate modifiers* of type <M, M>. They take the complex monadic predicate formed at Domain 1 (via M-junction and D-junction), and map it to another monadic predicate.[49] Like in Domain 1, the SEMs of complex phrases in Domain 2 are of the type <M>. However, these can be formed in a non-conjunctive manner that results in the lack of entailment between the complex SEM and its constituent SEMs. A clear example is negation: putting a VoiceP under the scope of a negation results in a SEM that no longer entails the VoiceP's SEM: obviously, *John is not here* does not entail *John is here*. Because of this, broadening the translation pipeline to Domain 2 cannot simply rely on conjunction as in Domain 1.

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are complementary with determiners, which motivates locating them to the higher D-domain (Abney 1987). However, these analyses are compatible: the possessor can be base-generated in Spec,PossP and subsequently raised to Spec,DP. This is in line with the general view that thematic relations are specified in Domain 1, from which the arguments can raise to higher domains to occupy specific grammatical roles (Plazack 2000, Grohmann 2003; see Chapter 3, Section 3.1.7). In effect, it generalizes the *VP-internal subject hypothesis* (Speas 1986, Koopman and Sportiche 1991) to the noun phrase.

[49] In effect, predicate modifiers require introducing *function application* as a mode of SEM-combination into the conjunctivist framework, albeit in a far more limited sense than in mainstream formal semantics. While this may initially seem to undermine the overall aims of conjunctivism, it is needed to allow ostensibly non-conjunctive SEMs at Domain 2. The novelty of conjunctivism is discarding *arbitrary* function application via typed lambda calculus, which is relied on in Montague semantics (see Chapter 4, Section 4.2.4). In the present framework, function application only appears in clearly restricted syntactic locations (at Domain 2), and can only map one type of input to the same type of output (<M>). This is a far cry from re-establishing anything like the standard Montagovian formalism with unrestricted types.

Nevertheless, I propose that the MTP is upheld even at Domain 2. Specifically, I posit that Domain 2 SEMs are dependent on their constituent SEMs, such that interpreting the former involves interpreting the latter in a manner that is (at least by default) needed for evaluating immediate entailment relations. Consequently, the complex SEM resulting from applying a predicate modifier is *strongly compositional* with respect to its constituent SEMs: it is not only their mathematical function, but a structural complex that genuinely *contains* them (Fodor and Mclaughlin 1990, Fodor and Lepore 2001, Pagin 2003).[50]

Chapter 5 (Section 5.2.3) discussed the effect of the Tarskian *arrow operators* ($\Uparrow$, $\Downarrow$) on immediate entailment. These turn a predicate $P(x)$ into a special type of predicate $\Uparrow P(x)$/$\Downarrow P(x)$, which applies to either everything or nothing based on whether $P(x)$ applies to something. The "positive" variant $\Uparrow P(x)$ applies to everything if $\exists x P(x)$, and otherwise applies to nothing. The "negative" variant $\Downarrow P(x)$ applies to everything if $\neg\exists x P(x)$, and otherwise applies to nothing. Both operators are assigned by some functional head in the T-domain, such as Tense,[51] Neg (for $\Downarrow$), or a generic polarity marker (Holmberg 2015). It was further shown in Chapter 5 that immediate entailment between $P(x)$ and $Q(x)$ necessarily secures immediate entailment between $\Uparrow P(x)$ and $\Uparrow Q(x)$, and will likely secure immediate entailment between $\Downarrow P(x)$ and $\Downarrow Q(x)$ under independently motivated assumptions.[52]

Unsurprisingly, translations of negated clauses in the Tatoeba data are indeed typically predictable from the translations of corresponding affirmed clauses, as in (264)–(265):

(264) a. olen tohtori
be.1SG.PRES doctor
'I am a doctor'

b. i am a doctor

(265) a. en ole tohtori
NEG be.PRES doctor
'I am not a doctor'

b. i am not a doctor

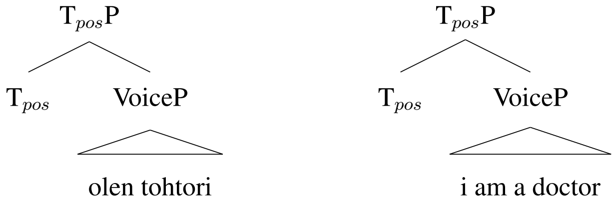
[50]Strong compositionality does not yet guarantee the determination of immediate entailment relations via the constituents, but the latter requires strong compositionality.

[51]For example, $\Uparrow_{pres}$ could be a present-tensed variant of $\Uparrow$, where $\Uparrow_{pres} P(x)$ applies to everything if $P(x)$ applies to something *at the present time*, and otherwise applies to nothing.

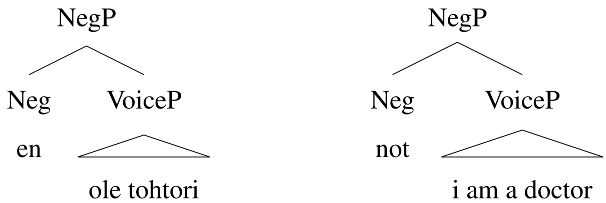
[52]$\Downarrow P(x)$ will immediately entail $\Downarrow Q(x)$ under conditions that correspond to evaluating immediate entailment given a background discourse. In data that is not specific to any particular discourse, reliance on discourse information is expected to be maximally general.

The SOs of (264)–(265) are shown in (266)–(267); using “T_{pos}” as a placeholder for the T-domain head that assigns ⇑, and assuming that ⇓ is assigned by Neg:

(266)



(267)



In both (266) and (267), the translations of the constituent VoicePs determine the translations of the respective T_{pos}Ps/NegPs with the corresponding arrow operators. Hence, the translation of affirmed or negated clauses is correctly predicted by the hypothesis that translation in Domain 2 is based on translating constituents, in line with the MTP.

Evidently, however, arrow operators are not the only kinds of SEMs available in Domain 2. For example, Holmberg et al. (1993) divide the Finnish TP into six projections, and Adger (2003) identifies four projections in the English TP (Section 6.5.4). Without going into further detail on the SEMs of these functional heads, they are plausibly analyzable as predicate modifiers of some kind, or alternatively have a purely grammatical status without a dedicated SEM. In the former case, mapping them to functional heads in another language can result in non-trivial challenges that manifest in translation data. An example of this was discussed in Section 6.5.4 with respect to the negation and modal auxiliaries.

The negation is above modals in Finnish TPs, but below modals in English TPs. This does not always matter for translation, as illustrated by (268):

(268) a. opiskelijat **eivät** **saa** mennä opettajainhuoneeseen
student.PL NEG.PL may.PRES go teacher’s-lounge.ILL
‘Students may not go to the teacher’s lounge’

b. students **may not** enter the faculty lounge

However, since scope can matter for predicate modifiers, sometimes the modal>negation scope needs to be attained by other means in Finnish. These include using negated infinitival clauses as in (269), or negated embedded clauses as in (270):

(269) a. tom **saattaa** jättää **tekemättä** mitä pyysit
tom might.PRES leave do.INF.NEG what ask.2SG.PAST
'Tom might leave undone what you asked'

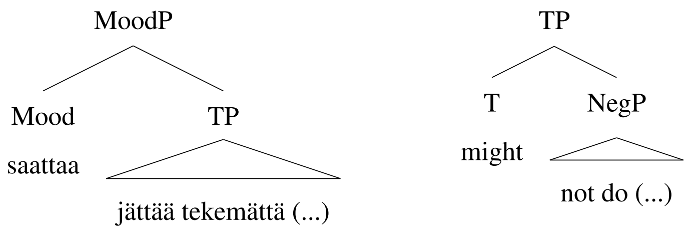
b. tom **might not do** what you asked

(270) a. **voi** olla , **ettei** se edes toimi
might be that.NEG 3SG even work.PRES
'It might be that it will not even work'

b. it **might not** even work

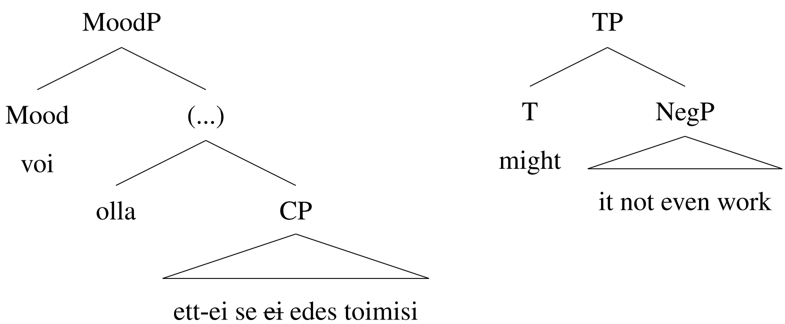
Despite grammatical divergences, (269a)–(270a) result in roughly equivalent SEMs with (269b)–(270b). The SOs of (269a–b) are schematically shown in (271), where the modal auxiliaries translate to each other, and the Finnish TP *jättää tekemättä* is equivalent with the English NegP *not do*:

(271)



The SOs of (270a–b) are schematically shown in (272), where the modal auxiliaries (*voi* and *might*) translate to each other, the Finnish copula *olla* and complementizer *että* (incorporating the negation) have no relevant SEM-effects, and the Finnish CP is equivalent with the English NegP:

(272)



Examples (271)–(272) illustrate that syntactic structure can be used to explain translation even across expressions that differ in multiple grammatical respects. Direct correspondence between SOs is ruled out due to the different ordering between modals and negation; but the resulting translations are nevertheless compositional.

So far, I have focused exclusively on the verbal Domain 2 – i.e. the split TP. Empirically, compositional translation is also manifested in the DP, as illustrated by the translations of determiner-noun phrases in (273)–(275):

(273) a.

kuka	on	**tuo**	**mies**	?
who	be.3SG.PRES	that	man	

'Who is that man?'

b. who is **that man** ?

(274) a.

onko	tässä	**jokin**	**ongelma**	?
be.3SG.PRES-Q	this.INE	some	problem	

'Does this have some problem?'

b. is there **some problem** ?

(275) a.

kaikki	**joutsenet**	ovat	valkoisia
all	swan.PL	be.3PL.PRES	white.PL.PART

'All swans are white'

b. **all swans** are white

Here, a Finnish and English DP translate to each other by virtue of sharing a syntactic structure and having constituents that translate to each other, as shown for the DPs of (273a–b) in (276), where translation obtains between the pairs *tuo–that* and *mies–man*:[53]

(276) [$_{DP}$ [$_{D}$ tuo] [$_{nP}$ mies]] [$_{DP}$ [$_{D}$ that] [$_{nP}$ man]]

Further details on the SEMs of determiners fall beyond the range of this dissertation, due to the significant complexities involved in quantification. The theory of *generalized quantifiers* is a major aspect of formal semantics (Mostowski 1957, Montague 1973, Barwise and Cooper 1981); and the treatment of quantification in conjunctivism is discussed in detail by Pietroski (2003, 2005a, 2018). Importantly, quantifiers relate two predicates instead of only modifying one. For example, the quantifier MOST in the sentence *most dogs bark* relates the predicate DOG to the event-predicate BARK. Because of this relationality, the basic predicate modifier analysis of Domain 2 SEMs is insufficient for quantifiers.

[53]For simplicity, I analyze the demonstratives (*tuo*, *that*) as D-heads, even though they may plausibly be specifiers instead (Giusti 1997, Lyons 1999, Brugè 2002, Alexiadou et al. 2007, Gröndahl 2014).

That notwithstanding, it is worth mentioning a crucial property of natural language quantifiers that also has important consequences for translation: their *conservativity* (Barwise and Cooper 1981, Romoli 2015). A function f that takes two monadic predicates P and Q as arguments is conservative iff $f(P)(Q) \Leftrightarrow f(P)(P \cup Q)$. For example, the quantifier *all* is conservative since *all cows are animals* is equivalent with the clumsy paraphrase *all cows are cows that are animals*, and the same can be applied for other English determiners like *most*, *some*, etc. Non-conservative determiners have been suggested to be non-existent across natural languages (Keenan and Stavi 1986), and psycholinguistic evidence indicates that children succeed at learning conservative determiners in an artificial language but fail to learn non-conservative determiners (Hunter and Lidz 2012).

While conservativity is not the same as strong compositionality, they are intrinsically linked: interpreting a conservative determiner depends on interpreting its complement (Barwise and Cooper 1981). For example, the application of EVERY DOG to some predicate P depends on the application of DOG to P (and only this; see Hunter and Lidz 2012: 4). Concurrently, it necessarily depends on the application of DOG. Thereby, conservativity illustrates that the SEM of *every dog* is constituted by *dog*. Hence, the conservativity of determiners corroborates the strong compositionality of DP-SEMs.[54]

This section has argued that the translations of functional projections in the syntactic Domain 2 can be predicted based on the translations of their syntactic constituents. The upshot is that the MTP can be generalized beyond Domain 1 to cover Domain 2 as well: if X_1 translates to Y_1 and X_2 translates to Y_2, then Merge(X_1, X_2) translates to Merge(Y_1, Y_2). Unlike in Domain 1 – where the MTP was proven to hold by default – in Domain 2 its validity needs to be stipulated as an empirical hypothesis due to the open-ended range of logically possible predicate modifiers. While broader evaluation is required in future work, this hypothesis receives support from TPs and DPs in Finnish-English translation.

[54]Strong compositionality alone does not require conservativity. For instance, *only* is not conservative: *only dogs bark* is not equivalent to *only dogs are dogs that bark*. However, it is strongly compositional, as the SEM of *only dogs* contains the SEM of *dogs* as a constituent. As Hunter and Lidz (2012: 3, Footnote 2) observe, *only* does not function syntactically like a determiner, and hence does not constitute a counter-example to the linguistic generalization that determiners are conservative.

6.7.5 Domain 3: linking

Domain 3 provides various ways in which the Domain 2 SEM can be *linked* to another representation, such as a different extended projection or a discourse representation (Chapter 4, Section 4.3.3). In the CP, the former possibility is manifested by *connectives*, and the latter by *Force* heads that mark the clause type as declarative, interrogative, or imperative. In the noun phrase, the status of Domain 3 is less clear, as discussed below. Like for Domains 1–2, I argue that the MTP is valid in Domain 3 as well.

Even though the SEMs of Force-heads do not enter into inferential relations as such (due to their non-predicative and non-propositional status), they nevertheless *respect* immediate entailment (Chapter 5, Section 5.2.3): if A immediately entails B, then declaring/asking/commanding A necessarily involves declaring/asking/commanding B; and there is no more informative target concept candidate that would be necessarily declared/asked/commanded via A. For present purposes, this suffices to ground the translation of ForcePs, assuming further that Force heads are shared between Finnish and English. This is borne out in the Tatoeba data: translations of declarative, interrogative, and imperative CPs share the translations of their constituent TPs, as exemplified by (277)–(279):

(277) a. tom **tekee** **töitä**
tom do.3SG.PRES work.PL.PART
'Tom works'

b. tom **works**

(278) a. **teetkö** sinä **töitä** ?
do.2SG.PRES-Q 2SG work.PL.PART
'Do you work?'

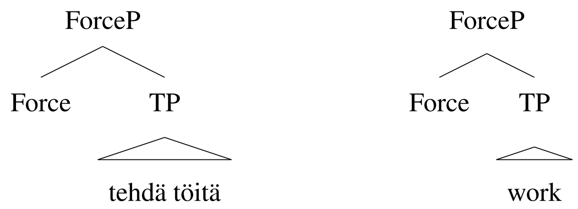
b. do you **work** ?

(279) a. **tee** **töitä** !
do.IMP work.PL.PART
'Work!'

b. **work** !

The Finnish construction *tehdä töitä* (lit. 'do work') translates to *work* in all cases, and the addition of the Force operator has no impact on this. Hence, all of (277)–(279) manifest the schematic SO (280) (abstracting away from the subject in Spec,VoiceP/Spec,TP):

(280)



Beyond Force heads, the C-domain can also contain *connectives*, which allow embedding the TP in another clause. Scrutinizing the SEMs of connectives is beyond my present capacities. I will only briefly mention two basic principles that would serve as starting points for their further analysis.

First, the *logical* aspect of a conditional's SEM determines how it truth-conditionally relates the two SEMs it links. Many connectives have a conjunctive interpretation, such as *and*, *but*, *when*, *while*, *whereas*, or *although*. Logically, their translation can thus be secured by the default status of conjunction in translating complex phrases, as with M- and D-junction (Section 6.7.3). Other connectives are non-conjunctive, such as *if*. Nevertheless, their logical aspect can be reformulated via conjunction and negation, which form a truth-functionally complete set of connectives.[55] Given that both negation and conjunction respect the MTP (Sections 6.7.3–6.7.4), the logical aspect of both conjunctive and non-conjunctive connectives can be analyzed without threatening the MTP.

Second, connectives also manifest a non-logical *pragmatic* aspect. For example, the difference between *and* and *but* has to do with whether the two connected SEMs somehow contrast each other in the relevant discourse. Translating this type of pragmatic content seems to involve some form of similarity in various kinds of metalinguistic information.

As expected, CPs headed by connectives are reliably translated via the MTP, as illustrated by (279)–(282) for the connectives *kun*–*when* and *jos*–*if*:

(281) a. lähdemme **kun lakkaa satamasta**
leave.1PL.PRES when stop.3SG.PRES raining.ELA
'We leave when it stops raining'

b. we 'll leave **when it stops raining**

(282) a. **jos sää on hyvä** , me saavumme sinne huomenna
if weather be.3SG.PRES good 1PL arrive.1PL.PRES there.ILL tomorrow
'If the weather is good, we arrive there tomorrow'

b. **if the weather is good** , we 'll get there tomorrow

[55] In informal notation, A IF B is equivalent with NOT (NOT-A AND B).

The embedded clauses of (281)–(282) are both compositional translations with respect to the complement TPs, as shown for (281) in (283):

(283)

CP
C kun
TP lakkaa satamsta

CP
C when
TP it stops raining

In the nominal extended projection, the status of Domain 3 is less clear. One possibility is to follow Grimshaw (1991) in treating *adpositions* as the nominal correlate of C (Chapter 4, Section 4.3.3). Even though adpositions are not among the main topics of this dissertation, I will briefly discuss their translation from this perspective.

Like the functional heads that trigger thematic roles in the verbal Domain 1 (Voice, F_{Theme}), adpositions also introduce dyadic relations between two arguments. When these relata are assimilated to the variables predicated over by the two argument SEMs,[56] the SEMs of PPs are covered by the general process of *D-junction*, as covered for Domain 1 in Section 6.7.3. The generic scheme is shown in (284):

(284)

PP [P DP] $\Rightarrow$ $\exists y$: SEM(DP)$(y) \wedge \text{R}(x, y)$

The PP can then be M-joined with another predicate in adjunction. As the resulting SEMs are accounted for by M- and D-junction, they are expected to be compositionally translated on the same grounds as Domain 1 SOs (Section 6.7.3). This is indeed true, as shown in (285)–(287), where the PP's translations are based on the translations of their complement DPs:

(285) a. et voi elää **ilman vettä**
NEG.2SG can live without water.PART
' You cannot live without water'

b. you can 't live **without water**

[56]Other PPs have non-conjunctive *intensional* SEMs. For example, *with ghosts* does not entail the existence of ghosts in the sentence *I would not like to live in a world with ghosts*. I leave the study of these complications for future work, along with the general treatment of intensional contexts within the conjunctivist framework. Empirically, there does not seem to be a difference in compositional translation between intensional and non-intensional PPs, which indicates that the translation pipeline is plausibly robust even in intensional contexts.

(286) a. juttelin **tomin** **kanssa** puoli tuntia
chat.1SG.PAST tom.GEN with half hour.PART
'I chatted with Tom for half an hour'

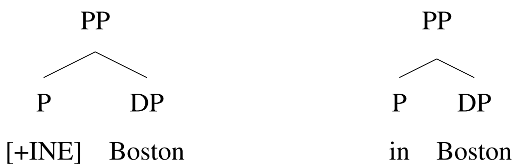
b. i spoke **with tom** for thirty minutes

(287) a. oletko **bostonissa** ?
be.2SG.PRES-Q boston.INE
'Are you in Boston?'

b. are you **in boston** ?

The examples also illustrate the three ways in which an English preposition can be translated in Finnish: a preposition in (285), a postposition in (286), or a semantic case in (287). In NS, I assimilate all to the same type of PP (see Section 6.5.3). The PPs of (287) are shown in (288), where the Finnish inessive case assigning P translates to *in*:

(288)



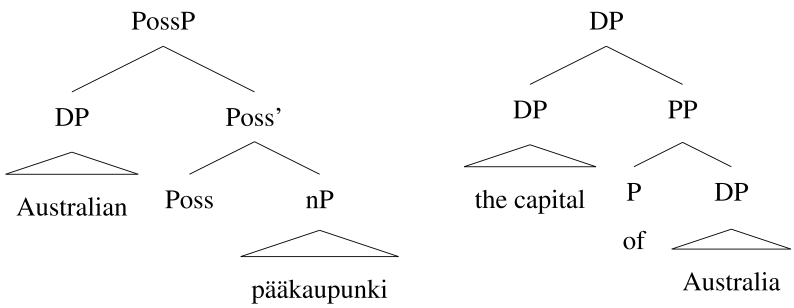
In addition, since the SEMs of PPs are determined via D-junction, it is predicted that their translations could also be argument-introducing functional heads at Domain 1. Indeed, a Finnish possessor can be translated to an English PP, as in (289):

(289) a. canberra on **australian** **pääkaupunki**
canberra be.3SG.PRES australia.GEN capital
'Canberra is Australia's capital'

b. canberra is **the capital of australia**

As shown in (290), the Finnish PossP and the English PP can be given a similar analysis, where the functional head (Poss or P) triggers the possession relation via D-junction:

(290)



Even though the PossP and PP assign the relata in different orders (the possessor being the PossP's specifier and the PP's complement), the resulting SEMs are equivalent. This illustrates that translation is not directly restricted by syntactic domains: a Domain 1 functional head (Poss) can be translated to a Domain 3 functional head (Poss) if their SEMs match. It thus provides additional corroboration of the hypothesis that translation is conducted at the level of SEMs rather than via the direct comparison of SOs as such. The syntactic correspondences between SOs and their translations arise indirectly due to the systematic links between syntactic domains and SEMs. In some cases, such as (290), this link is loosened due to the availability of equivalent SEMs on different domains.

6.7.6 Idioms

As idiomatic translation relies on additional memorized information (on the level of SEM-rules or inferential relations between SEMs), there are *ipso facto* no default generalizations abut it:[57] the idiomatic translation of one expression does not reveal the idiomatic translation of another expression.[58] Nevertheless, there is an observable tendency of idioms to be translated as *other idioms*, which calls for an explanation. Examples (292a–d) show different Finnish translations of the English idiom *kick the bucket* ('die') in the Tatoeba corpus:[59]

(292) a. potkaista tyhjää
kick empty.PART
lit. 'kick emptiness'

[57]The default status of compositional translation does not imply that idiomatic translation is not central in translation performance. Given that regular retrieval facilitates memory consolidation (Hulbert and Norman 2015, Antony et al. 2017, Ye et al. 2020), idiomatic translation might even be privileged over compositional translation in actual translation performance, when available. I am not committed to this conjecture, but it would be compatible with my approach.

[58]Of course, the idiomatic translation of an expression can reveal something about the translation of another expression where the same idiom appears. For example, how to translate the idiom *kick the bucket* tells us something about how to translate *John kicked the bucket*. However, this predictive power arises from the *compositional* relation between *John* and the idiomatic verb phrase.

[59]In addition, *kick the bucket* is translated compositionally as (291):

(291) potkaista ämpäriä
kick bucket.PART
lit. 'kick a/the bucket'

b. heittää veivinsä
throw crank.GEN.3-POSS
lit. ‘throw his/her/their crank’

c. heittää lusikka nurkkaan
throw spoon corner.ILL
lit. ‘throw a spoon into the corner’

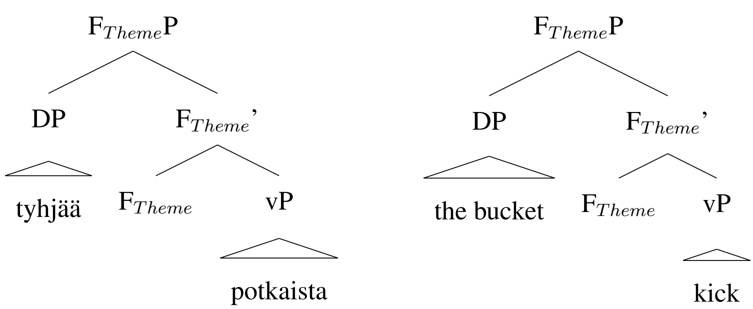
d. heittää henkensä
throw spirit.GEN.3-POSS
lit. ‘throw his/her/their spirit’

What is striking in (292)–(291) is the lack of a single-root translation for *kick the bucket*, despite its availability in principle: the verb *kuolla* (‘die’). The idiom is prone to be translated as another idiom rather than a root, even though nothing in its SEM requires this.

A possible explanation of why the idiom lacks a root translation is that the *opposite* translation direction is blocked. The default translation of a (categorized) root is another (categorized) root (Section 6.7.3). Consequently, a root is not translated into an idiom if an appropriate root translation is available. In a bidirectional corpus (such as Tatoeba), an idiom-root translation would need to function as a root-idiom translation in the other direction. This would violate the principle of root-to-root translation.

The syntax of idioms is a much-discussed topic, and has important implications for the syntax-semantics interface. An influential hypothesis concerning idiomatic verb phrases is that internal arguments (e.g. THEME) can be parts of an idiom while external arguments (e.g. AGENT) cannot (Marantz 1984, Anagnostopoulou and Samioti 2013, Harley and Stone 2013). For example, all of the translations of *kick the bucket* in (292a–d) are F_{Theme}Ps, as is *kick the bucket* itself. This comparison is shown for (292a) in (293):

(293)



Without going further into the syntax of idioms here, for now it suffices that idiomatic translations systematically have the same syntactic status as their source expressions. In addition, idiom-to-idiom translation can be bolstered as the pipeline’s indirect consequence.

6.7.7 Translation shifts in light of the pipeline

To account for observed translation shifts, Section 6.5 identified 19 points of (morpho)syntactic variation between Finnish and English, which were further allocated to five types: (i) the presence/order of functional heads, (ii) morphological marking, (iii) movement/EPP, (iv) linearization, and (v) selectional constraints. Together with lexical shifts (Section 6.6), there are thus six main types of translation shifts of interest. This section discusses how each of these types relates to the translation pipeline.

Presence/order of functional heads. This type covered four points of variation: negation position (above tense/modals in Finnish, below tense/modals in English), mandatory determiners (only present in English), negative determiners (only present in English), and certain participial clauses (only present in Finnish). Negation position was discussed in Section 6.7.4, and can result in grammatical divergence between Finnish and English when enforcing the modal>negation order in Finnish. The rest are addressed below.

Finnish noun phrases without overt determiners can be analyzed as either having a phonologically covert D or lacking the D-projection in total. The former view would allocate the variation to PF and thus have no relevance for the translation pipeline. In the latter case, English would require marking a semantic feature (definiteness) that Finnish can remain agnostic about. This would contrast the MTP, since the added determiner would not translate to anything in the Finnish counterpart.

Translating a determiner-free Finnish noun phrase to an English DP can be analyzed in the same way as the addition of gender information as discussed in Section 5.2.2 of Chapter 5. New information (not entailed by the source) is included in the target only when mandated by some reason, such as the grammatical requirements of the target language. When this is done, two conditions are upheld: (i) the added information must be true in the discourse, and (ii) its addition is minimized according to principle (79), repeated as (294):

(294) **Avoid superfluous discourse information:**
If A immediately entails both B_1 and $B_1 \wedge B_2$ in domain δ given discourse **D**, choose B_1 over $B_1 \wedge B_2$.

English requires D to be present for marking definiteness, which mandates its addition. The discourse determines whether the Finnish noun phrase should be interpreted as definite or indefinite. This discourse information is used to make the judgement of what type of D is added to the English target. While the discourse might also contain other information that could be added to the target, principle (87) restricts this.

Negative determiners are quantifiers, which were briefly discussed in Section 6.7.4. As shown in Section 6.5.10, English negative determiners are typically translated to the Finnish clausal negation. Assuming that determiners reside in the nominal Domain 2, this is thus in line with the translation pipeline's prediction that Domain 2 heads are translated to other Domain 2 heads. Hence, the allocation of both nominal and clausal negation to Domain 2 allows covering their translation without challenging the translation pipeline.[60]

Following Koskinen (1998), I analyze Finnish participial clauses as having verbal argument structure combined with higher nominal/adjectival functional projections (Section 6.5.18). Hence, their divergence from English finite or infinitival TPs concerns Domain 2, argument structure being assigned at Domain 1. With respect to Domain 2 heads, the translation pipeline only predicts that these are translated into other Domain 2 heads, and remains silent about their other grammatical properties. Translation between Finnish participial clauses and English finite/infinitival clauses thus fits the pipeline.

Morphological marking. Differences in the morphological marking of corresponding functional heads covered translation shifts concerning pro-drop, semantic case, covert complementizers, aspect marking, infinitive marking, covert relative pronouns, and degree marking. In the present theoretical framework, these are all allocated to PF. Hence, they have no impact on the translation pipeline, which only concerns NS and PHONs.

Movement/EPP. Finnish and English differ in head-movement of the verb, the mandatory status of expletive subjects (and hence the EPP), the availability of a generic question particle, and the frequency of focus movement. Verb-movement and expletive insertion lack semantic interpretation, and hence have no impact on the translation pipeline.

The Finnish generic question particle *-kO* allows turning a lexical phrase into a question phrase that retains its other contents. English lacks a similar functional head, and must use other means to induce a similar reading. This is illustrated in (295), where adding *-kO* to the pronoun *sinä* ('you') turns it into a question phrase that is raised to Spec,CP and receives the interpretation 'was it you...':

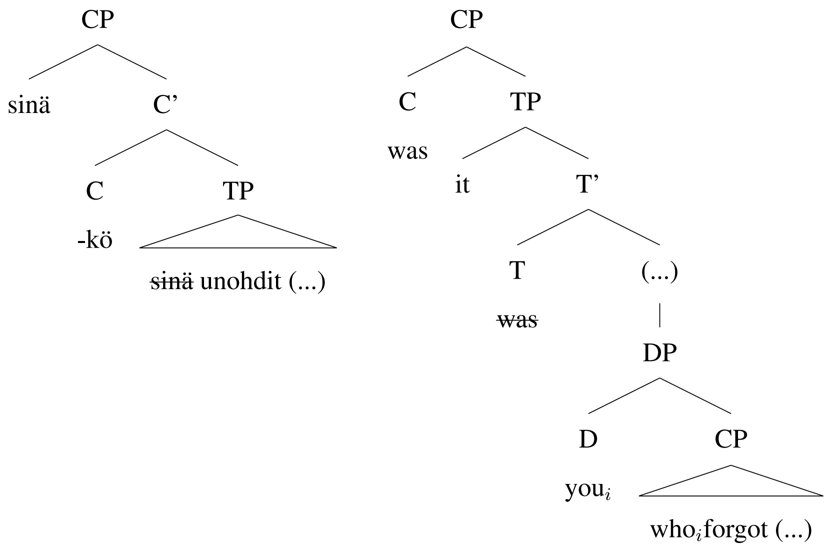
[60] Going further into the semantics of negative determiners (and quantifiers in general) would require addressing *quantifier raising*, not discussed in this dissertation due to the many complexities involved (but see e.g. May 1977, 1985, Hornstein 1995, Heim and Kratzer 1998, Wurmbrand 2018, Barker 2020).

(295) a. **sinäkö** unohdit lukita sen oven
2SG-KO forget.2SG.PAST lock that door.GEN
'Was it you who forgot to lock that door?'

b. **was it you** who forgot to lock the door ?

In (295b), the clause *was it you* has an equivalent reading to the Finnish *sinäkö*, and the relative clause *who forgot to lock the door* (where *who* is co-referential with *you*) translates to the Finnish *sinä unohdit lukita oven* (where *sinä* in the subject position is subsequently raised to Spec,CP). The respective SOs are schematically shown in (296):

(296)



Even though there is no compositional translation from *sinäkö* to *was it you*, nevertheless the combination of *sinäkö* with its complement TP corresponds to the combination of *was it you* with its complement relative clause.

With respect to focus movement, the operation itself is available in both languages, but more prevalently used in Finnish (Section 6.5.19). Since its pragmatic motivation is highly context-dependent, the translation pipeline does not allow specific predictions about its use. On a high level, one possibility is that the Finnish and English Force heads are distinct and have different (albeit largely overlapping) SEMs. For instance, if the English variant has a stronger focusing effect than the Finnish one, it is expected to be used less readily. Further work is needed to better understand the typology of focus, but its possibility to vary across languages does not threaten the translation pipeline.

Linearization. Variation in linear order between corresponding SOs accounts for translation shifts concerning pre-/postpositions, adverb order, and the position of conditional clauses. I have adopted the standard DM view that the linearization algorithm at PF can vary between languages (Section 6.5.8). As variation in linearization does not concern NS or PHONs, it has no impact on the translation pipeline.[61]

Selectional constraints. The only translation shifts allocated to this class involved the addition of the neutral third person pronoun (*se*) in Finnish, to turn a CP into a DP. This makes no recognizable difference to SEMs. Since the resulting DP is SEM-equivalent with its complement CP, translation between the latter and the English CP also secures translation between the Finnish DP and the English CP.

Lexical shifts. As covered in Section 6.6, there were 128 lexical shift types in the Finnish-English direction, and 75 in the English-Finnish direction. In both languages, the added material was typically functional rather than lexical. Prominent additions included prepositions and the copula or other "light" verbs. Lexical shifts fall outside the translation pipeline, since their syntactic structure cannot be predicted from the source's syntax.

The results are especially relevant for assessing the status of *construction-specific* information for translation. Such information is not compositionally determined by constituent structure, and hence needs to be separately memorized. Constructionist frameworks have been prominent in prior contrastive research (Chesterman 1998, Barkow 2008, Leino 2010) and translation studies (Tabakowska 1993, Halverson 2009, Szymánska 2011, Serbina 2015). On a high level, construction-specific information could be analyzed as operating in parallel with NS and compositional SEM-rules (e.g. Dupre 2021: 628),[62] or alternatively as replacing them altogether with a fully construction-centric system (Croft 2003, Tomasello 2003, Goldberg 2006).[63] Overall, my results speak in favor of the first alternative and against the second.

While lexical shifts are an important aspect of the data, they are a clear minority of all translation shifts, of which 84.9% are syntactic and 86.2% either syntactic or orthographic (see Section 6.5). All lexical shifts (in both translation directions) are further covered by 171 higher-level classes, of which 51 are construction-specific (based on the criteria given in Section 6.6.1). These numbers are notable enough to illustrate the need for incorporating

[61] In a movement-based account of word-order variation (Kayne 1994; see Chapter 3, Sections 3.1.8 and 3.2.4), word-order variation could potentially have SEM-effects with respect to e.g. scope. No such differences were found in the Finnish-English linearization shifts.

[62] Formally, non-compositional SEMs can be analyzed as syntactic phrases that receive a special non-compositional SEM via a process such as phrasal Spell-Out (Starke 2009, 2014), spanning (Svenonius 2016), or Vocabulary Insertion conditioned by the syntactic environment (Harley 2014; see Chapter 4, Section 4.3.1).

[63] For contrasting views on the linguistic status of constructions, see e.g. Adger (2013b) and Goldberg (2013).

constructions into a satisfactory account of translation. At the same time, they are plausibly low enough to allow treatment as explicitly memorized *exceptions* to the default status of compositional translation.[64]

6.8 Summary

This chapter has applied the theoretical framework developed in Chapters 3–5 to Finnish-English translation data annotated with a combination of automatic and manual techniques. Of the 45475 translation shifts found in the Tatoeba corpus, 84.9% are accounted for by 19 syntactic points of variation, while 12.7% are genuinely lexical (or constructional). After manual lemmatization, all lexical translation shifts are covered by 171 classes. Together, syntactic, lexical, and orthographic translation classes cover 98.9% of all translation shifts. The results demonstrate the applicability of the theoretical framework to large-scale translation data, as well as the significant explanatory coverage of syntactic analysis in comparison to the modest (albeit non-negligible) role of construction-specific information. Methodologically, the study illustrates the applicability of parallel corpora in theory-driven linguistic analysis.

Additionally, this chapter formulated a generic pipeline for predicting syntactic structures in Finnish-English translation. While the predictions are fallible, they robustly characterize default cases. The pipeline's reliance on the MTP makes it *productive* for translating complex phrases. Its predictions were first grounded theoretically, and subsequently corroborated using translation data from the Tatoeba corpus.

In future work, similar studies should be extended to other language pairs across a broader typological spectrum. The theoretical basis of the pipeline should also be strengthened with respect to Domains 2–3. I provided reasons for supporting the pipeline's validity across some Domain 2–3 heads (polarity markers, Force, connectives, determiners, adpositions), but their possibly non-conjunctive status makes it difficult to assess their overall adherence to the MTP. Therefore, evaluating the translation of higher-domain functional heads constitutes an important challenge for further empirical research. Concurrently, these considerations should be incorporated to the conjunctivist syntax-semantics interface theory.

[64]For comparison, Brysbaert et al. (2016) evaluate that an average native speaker of American English has memorized 42000 words (ignoring inflection) and 4200 additional constructions. Adding explicitly memorized translation shifts in the magnitude of hundreds or even some thousands would thus not require substantial changes to the assumed quantity of explicitly memorized linguistic information.

Chapter 7

Conclusions

In this dissertation, I have outlined a novel theoretical framework for analyzing translation competence as part of bilingual I-language, and applied the framework to corpus data on Finnish-English translation. This concluding chapter summarizes the main answers given to the five research questions (Section 7.1), and proposes directions for future work (Section 7.2).

7.1 Revisiting the research questions

Chapter 1 introduced the research questions Q1–Q5:

Q1. How are languages differentiated in bilingual cognition?
Q2. How are concepts constituted and related to language(s)?
Q3. What semantic/conceptual relation is required for translation?
Q4. How can parallel corpora be utilized for large-scale theoretical contrastive analysis?
Q5. How to account for observed translation shifts between Finnish and English?

Chapter 3 proposed an answer to Q1, Chapter 4 to Q2, Chapter 5 to Q3, and Chapter 6 to Q4–Q5. These answers are summarized below.

Q1. In a bilingual I-language, "languages" can be assimilated to maximal sets of mutually compatible PF-rules. This indirectly results in the language-specificity of SOs via their pronounceability. When the SEMs of such SOs are not shared with SOs of other languages (i.e. SOs pronounceable via other maximal sets of mutually compatible PF-rules), those SEMs are also indirectly language-specific. However, no computationally recognizable notion of "language" directly concerns the Lexicon, NS, or SEMs.

Q2. Atomic concepts are structurally combinable pointers to conceptual memory locations, allocable to different types that determine the possible modes of combination for constructing complex concepts. Concepts provide SEMs for SOs via an insertion process similar to Vocabulary Insertion at PF. Only a small subset of possible conceptual types is available for SEMs (<M>, <D>, <M, M>), and complex SEMs are formed in accordance with the conjunctivist framework – with further restrictions based on syntactic domains.

Q3. Translation involves establishing *immediate entailment* between the SEMs of the source and target expression. As an inferential relation, immediate entailment is not dependent on constitutive overlap between the SEMs, and hence allows translation even if SEMs vary between languages. This constitutes a novel resolution to the conflict between semantic universalism and linguistic relativism, neither of which is empirically viable.

Q4. Parallel corpora can be considered as repositories of translation judgements, which makes them relevant not only in data-driven research but also for theoretical linguistics where judgements provide the main source of evidence. Automatic alignment tools (such as GIZA++) can be applied to large parallel corpora for obtaining a manageable set of alignments, which can then be further manually labeled. It is reasonable to begin with fairly theory-neutral superficial labels (based on e.g. part-of-speech categories broadly recognized by linguists working from different theoretical standpoints), and work up to more theory-specific categorization. This method was successfully applied to the Finnish-English Tatoeba corpus.

Q5. Of 45475 translation shifts found in the Finnish-English Tatoeba corpus, 84.9% are covered by 19 syntactic points of variation, allocable to five high-level classes: (i) presence/order of functional heads, (ii) morphological marking, (iii) movement/EPP, (iv) linearization, and (v) selectional constraints. Beyond these, 12.7% of the shifts are lexical/constructional (covered by 171 types after manual lemmatization) and 1.3% orthographic. Together, syntactic, lexical, and orthographic translation classes cover 98.9% of the translation shifts. The results are in line with predictions made by the generic translation pipeline based on the theoretical framework laid out in Chapters 3–5. While lexical/constructional shifts deviate from the pipeline's predictions, they are plausibly accounted for as memorized exceptions to the default pattern of compositional translation.

7.2 Prospects for future work

As each of the chapters has emphasized, both the theory (Chapters 3–5) and its application (Chapter 6) only concern relatively basic aspects of translation, leaving many questions open. Ideas and results presented in this dissertation also have important connections to other fields, such as cognitive psychology and machine translation.

My account of bilingualism is based around PF-rules, but I have remained relatively agnostic about their specific nature, beyond using the standard DM formulation of Vocabulary Insertion. Further work is needed to accommodate the analysis with more elaborate accounts of PF, incorporating Vocabulary Insertion, linearization, (morpho)phonology, and phonetics. The *compatibility* relation between PF-rules was also described in a generic manner that allows many different interpretations. An important aspect of future work is developing more rigorous models of how such compatibility could be analyzed in further detail, and relating this with prior work on bilingual acquisition (e.g. Yang 2018, Slabakova et al. 2020) as well as neurolinguistic considerations (e.g. Paradis 2004, Friederici 2017).

Better integration between fields is also needed in the domain of conceptual cognition, where high-level analyses (such as the one presented in Chapter 4) remain insufficiently linked to considerations of their biological realization.[1] More work is needed on the representational format of concepts, as well as restrictions on their possible types. Furthermore, non-conjunctive modes of combination need to be understood more thoroughly, especially in relation to compositionality and the respecting of entailment relations.

While the theory allows SEMs to vary across languages without succumbing to linguistic relativism, the actual extent of semantic variation between languages remains an empirical matter. Assessing the extent of SEM-divergence in light of typological (as well as cultural/historical) variation is a crucial part of understanding translation. In addition, since translation is treated as an inferential relation, better integration with cognitive theories of inference is worth investigating.[2] So far, experimental assessment of formal syntax-semantics interface

[1]For discussion on the challenges and prospects of integrating computational and neurological levels of explanation, see Gallistel and King (2009), Marcus et al. (2014) and Trettenbrein (2016).

[2]Prominent approaches to inference in cognitive psychology include mental logic accounts (Braine and O'Brien (ed.) 1998), mental model accounts (Johnson-Laird 2010), and probabilistic accounts (Oaksford and Chater 2001). An influential view proposes dividing reasoning to two kinds based on speed, abstractness, parallelity/sequentiality, conscious access, evolutionary history, and neurological location (Kahneman 2011). Such a

theories has been conducted on e.g. the interpretation of quantifiers (Pietroski et al. 2009, Lidz et al. 2011) and the mass/count distinction (Odic et al. 2018). Extending this line of research to inter-lingual comparison is an intriguing prospect.

Application-wise, an evident extension of the dissertation would be to study other language pairs in a similar way. Parallel corpora have extensive potential for combining corpus-driven techniques with manual analysis, and should thus be utilized even within frameworks outside traditional data-driven corpus studies. Evaluating language pairs between different typological classes is especially relevant for the proper scrutiny of the theory developed here.

Another venue for expanding the research would be to find connections to machine translation (MT). Contemporary MT is centered around *supervised learning* using *deep neural networks* (DNNs), which are taught on parallel corpora to produce target expressions based on source expressions (Bahdanau et al. 2015, Wu et al. 2016, Johnson et al. 2017, Vaswani et al. 2017). Compared to human (natural) translation competence, this methodology contrasts the hypothesis that translation arises as an *automatic* consequence of bilingualism, without the need for separate training (Harris 1976). This hypothesis better fits the nascent field of *unsupervised MT*, where the training corpora do not include explicit translation examples (Conneau et al. 2017, Lample et al. 2017, 2018, Artetxe et al. 2018a,b, Conneau and Lample 2019). Incorporating more theory-driven methods can be of help here, given their availability even in the absence of large training corpora. In Gröndahl (2021) I provided a novel conjunctivism-inspired format for computational semantics, which further corroborates the concrete applicability of the conjunctivist theory. A possible extension of this line of work would be to extend similar ideas to MT.

Finally, similar studies to this dissertation should also be conducted from alternative theoretical standpoints, in order to compare their benefits and shortcomings. The results presented in Chapter 6 give support for the theoretical framework laid out in Chapters 3–5 by demonstrating its explanatory power with novel data. However, this alone remains insufficient for establishing the framework as the only viable option, and further consideration of other alternatives is needed. In general, constructive interaction between differing viewpoints should be enhanced to yield genuine scientific progress.

"two-system" approach partially contrasts the picture of linguistic and conceptual cognition presented in Chapters 3–4, which manifests some of the properties characteristic of Kahneman's "System 2" (e.g. symbolicity and abstractness) but not necessarily others (e.g. slowness or conscious access).

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Appendix A

Data

This appendix provides the full translation shift data obtained via GIZA++ alignment from the Finnish-English Tatoeba corpus, along with my manual annotations. Tables A.1–A.9 contain Finnish-English unit shifts, Tables A.10–A.11 English-Finnish unit shifts, and Table A.12 word-order shifts. (Disclaimer: the data contains a few curse-words.)

Source	Target (count)	Annonation
täytyy	've got (57)	AUX
täytyy	'll have (29)	AUX
täytyy	will have (16)	AUX
palaan	i 'll be back (16)	PRN-SUBJ AUX LEX
tulen	i will (23)	PRN-SUBJ
tulen	i 'll be (22)	PRN-SUBJ AUX
tulen	i 'll (21)	PRN-SUBJ
tulen	i 'll come (19)	PRN-SUBJ AUX
tulen	i come (18)	PRN-SUBJ
tulen	i will come (12)	PRN-SUBJ AUX
en	i 't (2232)	PRN-SUBJ
en	i 'm (470)	MST
en	i don (227)	PRN-SUBJ
en	don 't (214)	AUX
en	i not (104)	PRN-SUBJ
en	i am (56)	MST
en	didn 't (27)	AUX
en	i 'll (25)	MST
en	'm not (22)	COP-NEG
en	won 't (19)	AUX
en	i no (11)	PRN-SUBJ
en	't i (10)	PRN-SUBJ
löydä	can find (22)	AUX
löydä	won find (12)	AUX
ei	doesn 't (731)	AUX
ei	didn 't (440)	AUX
ei	don 't (353)	AUX
ei	isn 't (165)	COP-NEG
ei	won 't (96)	AUX
ei	's not (59)	COP-NEG
ei	does not (42)	AUX
ei	there is (39)	MST
ei	there 's (33)	MST
ei	is not (27)	COP-NEG
ei	is no (19)	COP-NEG
ei	wasn 't (18)	COP-NEG
ei	it is (14)	MST
ei	has no (14)	AUX
ei	can 't (12)	MST
ei	's no (10)	AUX
tiedä	don know (260)	AUX
olin	i was (291)	PRN-SUBJ
olin	i had (17)	PRN-SUBJ
kuva	picture of (12)	P
minulla	i have (476)	LEX
minulla	i 'm (112)	LEX
minulla	i 've (100)	LEX
minulla	i am (17)	LEX
minulla	i had (11)	LEX
minulla	i don (10)	LEX
maailman	the world (55)	DET
maailman	in the world (26)	P DET
olet	you 're (459)	PRN-SUBJ
olet	you are (131)	PRN-SUBJ
olet	are you (118)	PRN-SUBJ
olet	you 've (100)	PRN-SUBJ
olet	have you (57)	PRN-SUBJ
olet	you have (20)	PRN-SUBJ
olet	you were (10)	PRN-SUBJ
kunnossa	all right (15)	LEX
tapahtumaan	going happen (10)	LEX
osaa	know how (24)	LEX
osaa	knows how (15)	LEX

Source	Target (count)	Annonation
koetan	'll try (12)	AUX
koetan	i 'll try (12)	PRN-SUBJ AUX
mulla	i 'm (10)	LEX
soitan	i 'll call (16)	PRN-SUBJ AUX
olen	i 'm (1295)	PRN-SUBJ
olen	i 've (478)	PRN-SUBJ
olen	i am (307)	PRN-SUBJ
olen	i have (98)	PRN-SUBJ
olen	i 'll (34)	PRN-SUBJ
olen	am i (20)	PRN-SUBJ
sanoin	i said (32)	PRN-SUBJ
sanoin	i told (13)	PRN-SUBJ
käskin	i told (16)	PRN-SUBJ
sinulla	you have (370)	LEX
sinulla	you 've (26)	LEX
sinulla	you 're (23)	LEX
sinulla	are you (12)	LEX
kanssani	with me (61)	P
sellaista	such thing (15)	LEX
halusin	i wanted (90)	PRN-SUBJ
valitettavasti	unfortunately , (20)	PCT
totta	it true (28)	MST
ihmisistä	, people (12)	PCT
tässä	there this (27)	MST
tässä	in this (18)	P
tässä	at this (16)	P
oletko	are you (323)	PRN-SUBJ
oletko	have you (273)	PRN-SUBJ
oletko	do you (21)	PRN-SUBJ
riippuu	depends on (13)	P
haluan	i want (609)	PRN-SUBJ
siitä	about it (109)	P
siitä	about that (44)	P
siitä	like it (11)	OTH
siitä	of that (10)	P
millaista	what like (24)	WH
olisi	would be (37)	AUX
olisi	'd be (14)	AUX
olisi	wouldn be (12)	AUX
olisin	i were (36)	PRN-SUBJ
olisin	i 'd (20)	PRN-SUBJ
olisin	i would (13)	PRN-SUBJ
saatan	i may (12)	PRN-SUBJ
saatan	i might (11)	PRN-SUBJ
tarkoita	doesn mean (23)	AUX
etten	i 't (38)	MST
etten	that i (13)	PRN-SUBJ
näin	i saw (127)	PRN-SUBJ
näin	this way (10)	LEX
näin	like this (10)	LEX
heräsin	i woke up (14)	PRN-SUBJ LEX
kello	time it (13)	MST
yksin	by myself (12)	LEX
yksin	by himself (10)	LEX
pelkää	is afraid (17)	LEX
pelkää	is afraid of (10)	LEX P
pidän	i like (208)	PRN-SUBJ
pitkään	long time (23)	LEX
olit	you were (68)	PRN-SUBJ
olit	were you (33)	PRN-SUBJ
kauan	long time (10)	LEX
tiennyt	didn know (198)	AUX
pystyt	you can (22)	PRN-SUBJ

Table A.1: Finnish-English unit shifts (1/9).

Source	Target (count)	Annonation
siihen	do it (62)	MST
siihen	at that (10)	P
siihen	do that (10)	MST
voit	you can (163)	PRN-SUBJ
voit	you may (31)	PRN-SUBJ
voit	can you (16)	PRN-SUBJ
välitä	't care (10)	AUX
vaikka	even though (48)	LEX
vaikka	even if (21)	LEX
kunpa	i wish (56)	PRN-SUBJ
voisin	i could (60)	PRN-SUBJ
japaniin	to japan (23)	P
inhoan	i hate (17)	PRN-SUBJ
sänkyyn	to bed (11)	P
pyysi	asked for (18)	P
kiitos	thank you (61)	LEX
et	you 't (305)	PRN-SUBJ
et	you 're (62)	MST
et	don 't (57)	AUX
et	you don (41)	PRN-SUBJ AUX
et	you not (26)	PRN-SUBJ
et	you don 't (20)	PRN-SUBJ AUX
et	't you (18)	PRN-SUBJ
et	don 't you (17)	AUX PRN-SUBJ
et	didn 't you (16)	AUX PRN-SUBJ
et	you aren (13)	PRN-SUBJ AUX
et	you are (12)	MST
tuntenut	didn know (12)	AUX
ymmärrä	don understand (72)	AUX
ymmärrä	can understand (10)	AUX
voin	i can (124)	PRN-SUBJ
voin	can i (56)	PRN-SUBJ
odottaa	wait for (16)	P
vai	isn 't (19)	OTH
vai	aren 't (10)	OTH
rakastan	i love (163)	PRN-SUBJ
enää	any longer (13)	LEX
pidä	don like (80)	AUX
sinusta	you think (24)	LEX
sinusta	about you (14)	P
tykkää	don like (11)	AUX
vihaan	i hate (72)	PRN-SUBJ
halunnut	didn want (80)	AUX
tekemistä	things do (10)	MST
luulet	do you think (33)	AUX PRN-SUBJ
luulet	you think (26)	PRN-SUBJ
tehnyt	didn do (11)	AUX
älä	don 't (943)	AUX
älä	do not (24)	AUX
älä	please don (14)	OTH
äitini	my mother (74)	PRN-POSS
puhu	don speak (24)	AUX
englantia	speak english (11)	MST
ette	you 't (49)	PRN-SUBJ
yritän	i 'll try (24)	PRN-SUBJ AUX
yritän	i 'm trying (21)	PRN-SUBJ COP-ING
yritän	'll try (14)	PRN-SUBJ AUX
yritän	i try (12)	PRN-SUBJ
yritän	'm trying (11)	COP-ING
puhutko	do you speak (24)	AUX PRN-SUBJ
minusta	i think (172)	LEX
minusta	about me (16)	P
haluaisitko	would you like (64)	AUX PRN-SUBJ

Source	Target (count)	Annonation
tapahtuu	going on (31)	LEX
tapahtuu	's happening (17)	COP-ING
tunti	an hour (11)	DET
japanilainen	a japanese (10)	DET
tekisi	would do (21)	AUX
tekisi	wouldn do (13)	AUX
tekisi	do would (10)	AUX
syö	is eating (11)	COP-ING
kotiin	at home (18)	P
paljon	lot of (228)	P
paljon	lots of (15)	P
sanotaan	do you say (26)	AUX PRN-SUBJ
sanotaan	they say (21)	PRN-SUBJ
saanko	may i (59)	AUX
saanko	can i (18)	AUX
emme	we 't (125)	PRN-SUBJ
emme	we 're (30)	MST
emme	we not (20)	PRN-SUBJ
emme	don 't (20)	AUX
emme	won 't (10)	AUX
appelsiinimehua	orange juice (11)	COM
näe	don see (12)	AUX
näe	can see (10)	AUX
olemme	we 're (163)	PRN-SUBJ
olemme	we are (43)	PRN-SUBJ
olemme	we 've (26)	PRN-SUBJ
olemme	we have (11)	PRN-SUBJ
näytät	you look (94)	PRN-SUBJ
nimeni	my name (53)	PRN-POSS
tykkään	i like (114)	PRN-SUBJ
käydä	to go (22)	TO
käydä	to visit (12)	TO
tunnin	an hour (37)	DET
kaukana	far away (18)	LEX
täältä	from here (43)	P
täältä	of here (22)	P
silmäni	my eyes (11)	PRN-POSS
unelmani	my dream (12)	PRN-POSS
katso	look at (42)	P
puhun	i speak (43)	PRN-SUBJ
parempi	'd better (22)	MST
yritin	i tried (38)	PRN-SUBJ
haluaa	will want (16)	AUX
saisinko	may i have (21)	AUX PRN-SUBJ
saisinko	may i (15)	PRN-SUBJ
saisinko	could i have (13)	AUX PRN-SUBJ
saisinko	please give me (10)	LEX
kuuluu	are you (17)	OTH
liikaa	too much (120)	LEX
siksi	that 's why (20)	LEX
valmis	be ready (12)	MST
haluaisin	i 'd like (187)	PRN-SUBJ AUX
haluaisin	i would like (34)	PRN-SUBJ AUX
elämäni	my life (45)	PRN-POSS
annan	i 'll give (13)	PRN-SUBJ AUX
pelkään	i 'm afraid (29)	PRN-SUBJ LEX
ethän	please don 't (24)	OTH AUX
kertonut	didn tell (13)	AUX
myöhemmin	later , (11)	PCT
voisitko	could you (102)	PRN-SUBJ
voisitko	would you (38)	PRN-SUBJ
voisitko	can you (20)	PRN-SUBJ
voisitko	will you (19)	PRN-SUBJ

Table A.2: Finnish-English unit shifts (2/9).

Source	Target (count)	Annonation
voisitko	could you please (12)	PRN-SUBJ OTH
voisitko	would you mind (12)	AUX PRN-SUBJ
voisitko	would you please (11)	PRN-SUBJ OTH
pidät	you like (25)	PRN-SUBJ
halua	't want (216)	AUX
halua	don want (117)	AUX
sataa	it 's raining (15)	EXP COP-ING
sataa	it 's (13)	MST
sataa	it rains (12)	EXP
eikö	isn 't (107)	COP-NEG
eikö	don 't (47)	AUX
eikö	aren 't (26)	COP-NEG
eikö	didn 't (20)	AUX
eikö	doesn 't (11)	AUX
eikö	can 't (10)	AUX
opiskelen	i study (23)	PRN-SUBJ
opiskelen	i 'm studying (10)	PRN-SUBJ COP-ING
kävin	i went (31)	PRN-SUBJ
aamulla	in morning (22)	P
kävimme	we went (10)	PRN-SUBJ
lontoossa	in london (10)	P
menimme	we went (19)	PRN-SUBJ
menet	you go (21)	PRN-SUBJ
jollei	unless you (12)	MST
tiesin	i knew (45)	PRN-SUBJ
sain	i got (60)	PRN-SUBJ
sain	i received (11)	PRN-SUBJ
sain	i had (10)	PRN-SUBJ
hänestä	about her (26)	P
hänestä	about him (19)	P
pystyä	be able (10)	LEX
tulin	i came (35)	PRN-SUBJ
tulin	i got (11)	PRN-SUBJ
myöhässä	being late (11)	LEX
katsomaan	to see (16)	P
vanha	an old (34)	DET
puhut	you speak (10)	PRN-SUBJ
milloin	when did (33)	MST
milloin	when will (15)	MST
milloin	when does (10)	MST
syödään	let 's eat (14)	LEX
opin	i learned (24)	PRN-SUBJ
sinulta	from you (12)	P
nukkuu	is sleeping (19)	COP-ING
henkeni	my life (11)	PRN-POSS
vaarassa	in danger (16)	P
osaatko	can you (51)	PRN-SUBJ
osaatko	do you (15)	MST
osaatko	do you know how (15)	PRN-SUBJ AUX OTH
teimme	we made (10)	PRN-SUBJ
aamiaiseksi	for breakfast (21)	P
tahdon	i want (17)	PRN-SUBJ
kuunnella	listen to (12)	P
odotan	i 'm (19)	MST
olisit	you were (11)	PRN-SUBJ
viitsi	come on (11)	OTH
minulta	from me (15)	P
voidaan	can be (15)	COP-PASS
voinko	can i (116)	PRN-SUBJ
voinko	may i (48)	PRN-SUBJ
kissani	my cat (21)	PRN-POSS
tarvitsen	i need (146)	PRN-SUBJ
huolta	care of (25)	P
teet	are you doing (24)	AUX PRN-SUBJ
teet	do you do (16)	AUX PRN-SUBJ
teet	you do (15)	PRN-SUBJ
tyytyväinen	satisfied with (16)	P
tyytyväinen	happy with (10)	P
viimeksi	was last time (17)	OTH
pidätkö	do you (45)	MST
pidätkö	do you like (33)	AUX PRN-SUBJ
tykkäätkö	do you like (24)	AUX PRN-SUBJ
tykkäätkö	do you (10)	MST
tästä	about this (42)	P
ulos	get out (11)	OTH
ollenkaan	at all (70)	LEX
lainkaan	at all (38)	LEX
aion	i 'm going (42)	PRN-SUBJ COP-ING
aion	'm going (13)	COP-ING
aion	i plan (12)	PRN-SUBJ
aion	i intend (10)	PRN-SUBJ
autoni	my car (37)	PRN-POSS
kerrot	you tell (10)	PRN-SUBJ
haluat	you want (113)	PRN-SUBJ
haluat	do you want (53)	AUX PRN-SUBJ
haluat	do want (28)	AUX
haluat	you like (25)	PRN-SUBJ
haluat	want go (12)	MST
haluat	you wish (11)	PRN-SUBJ
puhuu	can speak (14)	AUX
käyn	i go (26)	PRN-SUBJ
otan	i 'll take (13)	PRN-SUBJ AUX
luulin	i thought (160)	PRN-SUBJ
menin	i went (76)	PRN-SUBJ
söin	i ate (41)	PRN-SUBJ
eivät	don 't (103)	AUX
eivät	aren 't (29)	AUX
eivät	won 't (16)	AUX
eivät	didn 't (15)	AUX
lähdin	i left (19)	PRN-SUBJ
tulee	will be (26)	AUX
tulee	will come (18)	AUX
tulee	is coming (15)	COP-ING
tulee	is going (14)	COP-ING
tulee	'll be (12)	AUX
kerro	tell me (12)	PRN-COMP
mieltä	do think (16)	MST
kanssaan	with that (24)	PRN-COMP
kanssaan	with him (13)	PRN-COMP
vietin	i spent (15)	PRN-SUBJ
tarvitse	don need (44)	AUX
teen	i 'll do (28)	PRN-SUBJ AUX
teen	i do (16)	PRN-SUBJ
myös	, too (53)	PCT
myös	as well (10)	LEX
sunnuntaina	on sunday (24)	P
pitkän	for long (16)	P
tiedät	you know (57)	PRN-SUBJ
koirani	my dog (13)	PRN-POSS
vihainen	angry with (25)	P
vihainen	mad at (19)	P
usko	don think (118)	AUX
usko	don believe (42)	AUX
etukäteen	in advance (10)	LEX
pitää	've got (14)	AUX
pitää	will have (10)	AUX

Table A.3: Finnish-English unit shifts (3/9).

Source	Target (count)	Annonation
pystytkö	can you (28)	PRN-SUBJ
häneltä	from him (14)	P
luule	don think (10)	AUX
luuletko	do you think (54)	AUX PRN-SUBJ
tahallaan	on purpose (12)	LEX
kiinnostunut	interested in (78)	P
sunnuntaisin	on sundays (43)	P
päiväkirjaa	keep diary (11)	MST
täytynyt	must have (10)	AUX
ylpeä	proud of (38)	P
saattanut	may have (13)	AUX
ainakin	at least (25)	LEX
vaikutat	you seem (18)	PRN-SUBJ
uskotko	do you believe (21)	AUX PRN-SUBJ
jumalaan	in god (14)	P
autosi	your car (11)	PRN-POSS
autoani	my car (14)	PRN-POSS
etkö	don 't you (35)	AUX PRN-SUBJ
etkö	can 't you (22)	AUX PRN-SUBJ
etkö	don 't (17)	AUX
etkö	aren 't you (14)	COP-NEG PRN-SUBJ
etkö	won 't you (13)	AUX PRN-SUBJ
etkö	didn 't you (10)	AUX PRN-SUBJ
etkö	didn 't (10)	AUX
tulet	you come (22)	PRN-SUBJ
teit	you did (27)	PRN-SUBJ
teit	you made (13)	PRN-SUBJ
teit	did do (12)	AUX
maanantaina	on monday (25)	P
suunnitelmasi	your plan (12)	PRN-POSS
oletan	i assume (14)	PRN-SUBJ
mielestäni	i think (23)	LEX
aiotko	are you going (26)	COP-ING PRN-SUBJ
kotona	at home (122)	P
montako	how many (57)	WH
aiot	are you going (21)	COP-ING PRN-SUBJ
aiot	will you (12)	PRN-SUBJ
haluatte	want go (12)	MST
oletteko	are you (28)	PRN-SUBJ
oletteko	have you (20)	PRN-SUBJ
mihin	where did (15)	MST
työskennellä	to work (15)	TO
läksysi	your homework (12)	PRN-POSS
parasta	'd better (18)	LEX
bussilla	by bus (15)	P
uskon	i believe (32)	PRN-SUBJ
uskon	i think (24)	PRN-SUBJ
mikset	why don 't (18)	WH AUX
mikset	why 't (11)	WH
tarvitset	you need (25)	PRN-SUBJ
japanissa	in japan (67)	P
kauanko	how long (11)	WH
tänne	over here (10)	P
pelaa	is playing (10)	COP-ING
voinut	couldn help (17)	LEX
loppuun	end of (10)	P
tiedätkö	do you know (133)	AUX PRN-SUBJ
tiedätkö	do know (29)	AUX
saat	you may (11)	PRN-SUBJ
heti	as soon (38)	LEX
heti	at once (30)	LEX
heti	right away (13)	LEX
menit	did you go (15)	AUX PRN-SUBJ

Source	Target (count)	Annonation
varmasti	must be (15)	LEX
monelta	what time (21)	WH
amerikassa	in america (11)	P
hotellissa	staying at hotel (23)	MST
hotellissa	at hotel (10)	P
kätesi	your hands (11)	PRN-POSS
anna	won let (10)	AUX
ihailen	i admire (10)	PRN-SUBJ
tiedän	i know (315)	PRN-SUBJ
nimesi	your name (36)	PRN-POSS
siskosi	your sister (17)	PRN-POSS
kirjasi	your book (12)	PRN-POSS
pöydällä	on table (24)	P
huoneesi	your room (12)	PRN-POSS
unohdin	i forgot (66)	PRN-SUBJ
kanssasi	with you (75)	P
kuule	can hear (14)	AUX
omista	your own (13)	PRN-POSS
palaa	is burning (13)	COP-ING
kuulin	i heard (79)	PRN-SUBJ
kuulin	i hear (15)	PRN-SUBJ
apuasi	your help (16)	PRN-POSS
näyttää	it looks (30)	EXP
näyttää	it seems (10)	EXP
luulen	i think (239)	PRN-SUBJ
luulen	i believe (10)	PRN-SUBJ
talosi	your house (10)	PRN-POSS
puolestasi	for you (14)	P
selville	find out (16)	MST
äitisi	your mother (12)	PRN-POSS
tilassa	in room (13)	P
aavistustakaan	no idea (24)	NEG-N
teistä	of you (22)	P
toivon	i hope (133)	PRN-SUBJ
toivon	i wish (60)	PRN-SUBJ
odottanut	been waiting for (15)	COP-ING P
odottanut	didn expect (10)	AUX
joessa	in river (12)	P
ota	help yourself (22)	LEX
ota	please help yourself (18)	LEX
reikä	hole in (12)	P
ostin	i bought (97)	PRN-SUBJ
ettei	doesn 't (21)	AUX OTH
ettei	didn 't (12)	AUX OTH
taivaalla	in sky (12)	P
aurinko	the sun (45)	DET
vesi	the water (16)	DET
päivittäin	every day (20)	LEX
syttyi	broke out (15)	LEX
yhteyttä	get in touch with (11)	LEX
ilmastointi	air conditioner (10)	LEX
olisipa	i wish (23)	LEX
yli	more than (42)	LEX
ensimmäinen	your first (15)	PRN-POSS
syntyi	was born (48)	COP-PASS
satoi	it rained (12)	EXP
maitoa	some milk (19)	DET
teillä	you have (64)	MST
koulusta	from school (22)	P
koulusta	for school (17)	P
jollet	unless you (15)	PRN-COMP
kiire	in hurry (18)	P
menen	i 'm going (41)	PRN-SUBJ COP-ING

Table A.4: Finnish-English unit shifts (4/9).

Source	Target (count)	Annonation
menen	i go (28)	PRN-SUBJ
menen	i 'll go (26)	PRN-SUBJ AUX
menen	'm going (12)	COP-ING
anteeksi	i 'm sorry (74)	LEX
anteeksi	excuse me (62)	LEX
anteeksi	pardon me (15)	LEX
voimme	we can (75)	PRN-SUBJ
voimme	can we (11)	PRN-SUBJ
välittömästi	at once (10)	LEX
tunnen	i know (43)	PRN-SUBJ
tunnen	i feel (14)	PRN-SUBJ
olette	you 're (40)	PRN-SUBJ
olette	you are (29)	PRN-SUBJ
olette	are you (15)	PRN-SUBJ
ystäväni	my friend (45)	PRN-POSS
ystäväni	friend of mine (15)	P PRN-POSS
ystäväni	my friends (12)	PRN-POSS
epäilen	i doubt (13)	PRN-SUBJ
varo	be careful (12)	LEX
katsoa	look at (11)	P
itsestään	about himself (11)	P
asun	i live (55)	PRN-SUBJ
vahingossa	by mistake (11)	P
voisinko	may i (17)	PRN-SUBJ
voisinko	could i (11)	PRN-SUBJ
kukaan	no one (132)	NEG-N
helppo	an easy (13)	DET
hauskaa	of fun (17)	P
hauskaa	good time (14)	LEX
hauskaa	much fun (10)	OTH
opiskelijat	the students (11)	DET
odottamassa	waiting for (10)	P
oppilaat	the students (12)	DET
kävelen	i walk (10)	PRN-SUBJ
puoli	at 2 (12)	MST
kuudelta	at six (10)	P
kuudelta	up at six (10)	MST
koulussa	at school (56)	P
koulussa	in school (19)	P
kysy	you ask (13)	PRN-SUBJ
puhumattakaan	not mention (18)	LEX
häivy	get out (10)	LEX
loppui	ran out of (10)	LEX
haluamme	we want (19)	PRN-SUBJ
tarvitsemme	we need (33)	PRN-SUBJ
aurinkoa	there was no sun (16)	MST
lisää	some more (12)	DET
toimeen	get along (18)	LEX
voimmeko	can we (26)	PRN-SUBJ
osa	part of (31)	P
meillä	we have (106)	LEX
meillä	we 've (28)	LEX
meillä	we 're (23)	LEX
vaimoni	my wife (32)	PRN-POSS
perheensä	his family (15)	PRN-POSS
poikani	my son (27)	PRN-POSS
perheeni	my family (26)	PRN-POSS
tulessa	on fire (10)	P
vastauksen	the answer (11)	DET
samaan	at same (13)	P
sisään	on in (11)	MST
välttämätöntä	it necessary (12)	EXP
haluaisit	would you like (16)	AUX PRN-SUBJ

Source	Target (count)	Annonation
takia	because of (19)	P
syötävää	to eat (21)	TO
tietoinen	aware of (14)	P
puuttuu	is missing (10)	COP-ING
ostitko	did you buy (18)	AUX PRN-SUBJ
edessä	in front of (53)	P ($\times 2$)
voitko	can you (110)	PRN-SUBJ
jotkut	some people (12)	LEX
maailmassa	in world (18)	P
englanniksi	in english (23)	P
englanniksi	into english (11)	P
elokuvissa	the movies (10)	DET
autossa	in car (18)	P
otin	i took (20)	PRN-SUBJ
pari	couple of (14)	P
tuntia	an hour (12)	DET
kävelylle	for walk (18)	P
mennään	let 's go (52)	LEX
mennään	let 's (17)	LEX
millainen	what kind of (12)	WH P
asua	live in (12)	P
mieluummin	'd rather (17)	AUX
haluatko	do you want (160)	AUX PRN-SUBJ
mukaan	with me (14)	LEX
tapasin	i met (58)	PRN-SUBJ
sattumalta	by chance (17)	P
kerron	i 'll tell (23)	PRN-SUBJ AUX
isääni	my father (11)	PRN-POSS
lopettamaan	stop from (12)	P
katsoi	looked at (21)	P
ajoissa	on time (33)	P
ajoissa	in time (17)	P
vaati	insisted on (10)	P
etsii	is looking for (19)	COP-ING P
sängyssä	in bed (36)	P
mennyt	didn go (11)	AUX
haluaisi	would want (12)	AUX
koostuu	consists of (10)	P
eroon	rid of (27)	P
vanhaa	your old (16)	PRN-POSS
vanhemmat	's parents (29)	MST
meistä	of us (31)	P
meistä	about us (11)	P
elämme	we live (12)	PRN-SUBJ
olimme	we were (39)	PRN-SUBJ
mukaasi	with you (13)	PRN-COMP
yhtään	at all (45)	LEX
juhlissa	at party (32)	P
ystävä	's friend (11)	MST
isä	's father (15)	MST
tunnettu	famous for (11)	P
lasin	glass of (17)	P
pääkaupunki	capital of (21)	P
matkalla	on way (11)	P
isäänsä	his father (11)	PRN-POSS
ravintolassa	at restaurant (10)	P
syön	i eat (29)	PRN-SUBJ
omenan	an apple (19)	DET
nimensä	his name (10)	PRN-POSS
sammuttaa	turn off (15)	LEX
pystyn	i can (29)	PRN-SUBJ
toivotan	i wish (11)	PRN-SUBJ
tehtävänä	to do (12)	TO

Table A.5: Finnish-English unit shifts (5/9).

Source	Target (count)	Annonation
tehdään	let 's do (11)	LEX
vihdoinkin	at last (11)	LEX
tietenkin	of course (10)	LEX
tekisit	would you do (13)	AUX PRN-SUBJ
veljeni	my brother (71)	PRN-POSS
tekisin	would i do (10)	AUX PRN-SUBJ
autolla	by car (13)	P
tuntuu	feel like (14)	P
yliopistossa	at college (14)	P
palan	piece of (10)	P
toisiamme	each other (26)	LEX
ainoa	only one (46)	LEX
täynnä	full of (40)	P
huoneessa	in room (44)	P
ketään	no one (18)	NEG-N
olipa	once upon (12)	OTH
olipa	once upon there was (11)	MST
lasillisen	glass of (13)	P
nähdään	see you (38)	LEX
nähdään	i 'll see you (10)	LEX
pariisissa	in paris (14)	P
ministerin	the minister (12)	DET
kerroin	i told (42)	PRN-SUBJ
pelkkä	just a (11)	DET
kylmä	cold today (12)	MST
metsässä	in forest (23)	P
näyttelijä	an actor (10)	DET
opiskelee	is studying (21)	COP-ING
nykyään	these days (13)	LEX
molemmat	both of (12)	P
joukko	set of numbers (11)	MST
elämänsä	his life (19)	PRN-POSS
vanhempi	older than (25)	OTH
kysyin	i asked (28)	PRN-SUBJ
mieli	feel like (90)	LEX
kutsutaan	is called (11)	COP-PASS
jossa	in which (10)	P
passini	my passport (13)	PRN-POSS
aluksi	at first (28)	LEX
tajunnut	didn realize (15)	AUX
ensimmäistä	for first (15)	P
suomessa	in finland (20)	P
pöydälle	on table (10)	P
istui	was sitting (12)	COP-ING
monet	lot of (38)	P
sijaan	instead of (14)	P
huolimatta	spite of (10)	P
kiinnostaa	is interested in (10)	LEX
tomilta	from tom (36)	P
sairaalassa	in hospital (19)	P
junalla	by train (18)	P
äitinsä	his mother (14)	PRN-POSS
asut	do live (10)	AUX
töissä	at work (18)	P
löysit	did you find (10)	AUX PRN-SUBJ
äidillesi	your mother (13)	PRN-POSS
sisareni	my sister (10)	PRN-POSS
naimisiin	get married (18)	MST
naimisiin	got married (10)	MST
syystä	some reason (11)	DET
teette	are you doing (10)	AUX PRN-SUBJ
isäsi	your father (18)	PRN-POSS
herätä	wake up (11)	LEX

Source	Target (count)	Annonation
seitsemältä	at seven (60)	P
älkää	don 't (116)	AUX
varaa	can afford (19)	LEX
muista	don remember (30)	AUX
muista	can remember (23)	AUX
poliisi	the police (53)	DET
hetken	for while (11)	P
hetken	for moment (11)	P
hampaasi	your teeth (10)	PRN-POSS
sateenvarjoni	my umbrella (13)	PRN-POSS
olevansa	he was (11)	PRN-POSS
olevansa	he 's (10)	PRN-POSS
matkaan	off , (21)	PCT
puistossa	in park (31)	P
määrä	number of (11)	P
olleet	weren 't (13)	AUX
vanhan	an old (15)	DET
tuohon	in that (11)	P
tuolla	over there (18)	LEX
turhaan	in vain (19)	LEX
isoisäni	my grandfather (16)	PRN-POSS
heistä	of them (36)	P
sekä	both and (30)	OTH
luin	i read (22)	PRN-SUBJ
mielenkiintoinen	an interesting (12)	DET
apua	for help (18)	P
tein	i did (47)	PRN-SUBJ
tein	i made (27)	PRN-SUBJ
sohvalla	on sofa (15)	P
ranskaksi	in french (100)	P
ranskaksi	into french (37)	P
istuu	is sitting (11)	COP-ING
kokouksessa	at meeting (11)	P
kirjastoon	the library (14)	DET
huoneeseen	into room (10)	P
puhuin	i spoke (15)	PRN-SUBJ
myrsky	the storm (10)	DET
nukahti	fell asleep (22)	LEX
isänsä	his father (24)	PRN-POSS
liikenneonnettomuudessa	in traffic accident (10)	P COM
vikaa	wrong with (10)	P
isäni	my father (123)	PRN-POSS
tuijotti	stared at (10)	P
nimi	's name (17)	MST
tuhansia	thousands of (10)	P
toisiaan	each other (23)	LEX
taloni	my house (17)	PRN-POSS
ilmastointilaite	air conditioner (14)	COM
näitkö	did you see (10)	AUX PRN-SUBJ
ajatella	think about (13)	P
yksityiskohtaisesti	in detail (11)	P
sanoit	you said (19)	PRN-SUBJ
sanoit	said you (12)	PRN-SUBJ
sanoit	did say (11)	AUX
poikansa	his son (16)	PRN-POSS
ajanhukkaa	waste of time (17)	COM P
poliisille	the police (19)	DET
löysin	i found (44)	PRN-SUBJ
kateellinen	jealous of (18)	P
ranskassa	at french (11)	P
ranskassa	in france (10)	P
paremmin	better off (27)	LEX
oman	his own (13)	PRN-POSS

Table A.6: Finnish-English unit shifts (6/9).

Source	Target (count)	Annonation
opiskelemaan	to study (15)	P
nuorempi	younger than (15)	MST
kanssamme	with us (36)	PRN-COMP
haluta	feel like (20)	P
näistä	of these (12)	P
talonsa	his house (12)	PRN-POSS
setäni	my uncle (24)	PRN-POSS
järkeä	make sense (10)	LEX
asuin	i lived (27)	PRN-SUBJ
tunnetko	do you know (10)	AUX PRN-SUBJ
alueella	in area (10)	P
italiassa	in italy (15)	P
paljonko	how much (46)	WH
ranskasta	from french (10)	P
ettet	you 't (15)	PRN-SUBJ
etsin	i 'm looking for (41)	PRN-SUBJ COP-ING P
arvoja	values between (26)	P
kupin	cup of (29)	P
käteni	my hands (11)	PRN-POSS
sanon	i say (13)	PRN-SUBJ
puhelimessa	on phone (45)	P
iltapäivällä	this afternoon (31)	DET
toivottavasti	i hope (40)	PRN-SUBJ
voisit	you could (22)	PRN-SUBJ
tätini	my aunt (10)	PRN-POSS
enoni	my uncle (14)	PRN-POSS
silmäsi	your eyes (11)	PRN-POSS
palata	go back (14)	LEX
puutarhassa	in garden (10)	P
sodassa	in war (11)	P
vaivaa	wrong with (11)	P
serkkuni	my cousin (14)	PRN-POSS
pelaan	i play (11)	PRN-SUBJ
roomassa	in rome (14)	P
yhteistä	in common (14)	LEX
siskoni	my sister (42)	PRN-POSS
lihaa	meat left (17)	MST
tuossa	at that (12)	P
tokiossa	in tokyo (29)	P
mukaani	with me (18)	PRN-COMP
kuulitko	did you hear (12)	AUX PRN-SUBJ
asunut	been living (13)	COP-ING
luet	you read (13)	PRN-SUBJ
vanhempasi	your parents (20)	PRN-POSS
erossa	away from (11)	P
ystäväsi	your friend (15)	PRN-POSS
annoin	i gave (32)	PRN-SUBJ
ajattelin	i thought (60)	PRN-SUBJ
ylihuomenna	day after tomorrow (10)	LEX
ottakaa	help yourself (14)	LEX
ottakaa	please help yourself (13)	LEX
join	i drank (15)	PRN-SUBJ
sujuvaa	fluent in (13)	LEX
yllätys	a surprise (10)	DET
isoveljeni	elder brother (14)	COM
isoveljeni	my elder brother (13)	PRN-POSS COM
tytöille	for girls (10)	P
keskittyä	should concentrate (10)	AUX
istuutui	sat down (11)	LEX
näen	i see (35)	PRN-SUBJ
näen	i can see (17)	PRN-SUBJ AUX
ymmärrän	i understand (29)	PRN-SUBJ
puistoon	the park (10)	DET

Source	Target (count)	Annonation
vastuussa	responsible for (23)	P
huvita	feel like (30)	LEX
päätin	i decided (17)	PRN-SUBJ
tarvitsin	i needed (16)	PRN-SUBJ
kirsikankukat	cherry blossoms (15)	COM
täydessä	in full (13)	P
jätin	i left (19)	PRN-SUBJ
opetan	i teach (11)	PRN-SUBJ
nukuin	i slept (16)	PRN-SUBJ
elämän	of life (12)	P
öisin	at night (12)	P
lompakkoni	my wallet (12)	PRN-POSS
näimme	we saw (14)	PRN-SUBJ
kirjoitin	i wrote (26)	PRN-SUBJ
syntymäpäivä	's birthday (18)	MST
tunne	don know (27)	AUX
leikkii	is playing (19)	COP-ING
tapasimme	we met (12)	PRN-SUBJ
rakastunut	in love with (33)	LEX P
rakastunut	in love (11)	LEX
voittaa	will win (12)	AUX
yrittää	is trying (14)	COP-ING
tomista	about tom (35)	P
vuosia	for years (12)	P
soittamaan	to play (12)	P
tulemme	we 'll (12)	PRN-SUBJ
tulevaisuudessa	in future (10)	P
tiedämme	we know (14)	PRN-SUBJ
rakasta	't love (10)	MST
muistatko	do you remember (23)	AUX PRN-SUBJ
australiassa	in australia (42)	P
opiskellut	been studying (37)	COP-ING
kelloni	my watch (13)	PRN-POSS
elämässä	in life (11)	P
pääministeriksi	prime minister (12)	COM
tietääkseni	as far as know , (11)	LEX
aviomieheni	my husband (10)	PRN-POSS
tyttäreni	my daughter (30)	PRN-POSS
pidätettiin	was arrested (11)	AUX
vähintään	at least (18)	LEX
tilasin	i ordered (14)	PRN-SUBJ
ajattelen	i think (10)	PRN-SUBJ
veljesi	your brother (13)	PRN-POSS
kirjoitan	i write (12)	PRN-SUBJ
vaimosi	your wife (12)	PRN-POSS
muistan	i remember (33)	PRN-SUBJ
luen	i read (19)	PRN-SUBJ
osaan	i can (46)	PRN-SUBJ
juoksin	i ran (10)	PRN-SUBJ
pyysin	i asked (26)	PRN-SUBJ
mutten	but i 't (10)	PRN-SUBJ
kesällä	in summer (10)	P
aio	not going (29)	MST
avaimeni	my keys (11)	PRN-POSS
kupillisen	cup of (10)	P
pulassa	in trouble (15)	P
kadotin	i lost (14)	PRN-SUBJ
sydämeni	my heart (17)	PRN-POSS
jumalan	of god (10)	P
huolissani	worried about (25)	P
synnyin	i was born (21)	PRN-SUBJ COP-PASS
huoneeni	my room (14)	PRN-POSS
valehteli	lied to (14)	P

Table A.7: Finnish-English unit shifts (7/9).

Source	Target (count)	Annonation
luota	don trust (12)	AUX
kuuntelen	i listen (10)	PRN-SUBJ
autonsa	his car (21)	PRN-POSS
minäkin	, too (21)	MST
kolmelta	: 30 (18)	MST
mielessä	in mind (10)	P
kiinnostuneita	interested in (11)	P
luonamme	with us (10)	P
hallitus	the government (10)	DET
onkohan	i wonder if (11)	PRN-SUBJ CMP
itkee	is crying (12)	COP-ING
toivotaan	let 's hope (13)	LEX
isoäitini	my grandmother (17)	PRN-POSS
pääministeri	prime minister (105)	COM
hyvällä	in good (16)	P
peitossa	covered with (15)	P
sairaalaan	the hospital (20)	DET
puhelimeen	on phone (13)	P
valehtele	not lying (10)	MST
yöllä	at night (12)	P
valehdellut	lied to (10)	P
silmänsä	his eyes (12)	PRN-POSS
sujuvasti	fluent in (15)	P
mieltään	his mind (10)	PRN-POSS
päätään	his head (17)	PRN-POSS
rakastui	fell in love with (11)	LEX P
ensisilmäyksellä	at first sight (12)	COM P
riisui	took off (11)	LEX
ymmärtänyt	didn understand (15)	AUX
lukee	is reading (14)	COP-ING
astronomiasta	about astronomy (19)	P
lapsesta	since i was kid (12)	LEX
lapsesta	since i was child (12)	LEX
kaunein	most beautiful (26)	DEG
menemistä	thinking about going (36)	MST
vaimo	's wife (15)	MST
aikoo	is going (13)	COP-ING
äiti	's mother (21)	MST
jäätelöä	ice cream (12)	COM
rakastatko	do you love (10)	AUX PRN-SUBJ
lainasin	i borrowed (10)	PRN-SUBJ
vanhempani	my parents (31)	PRN-POSS
jääkaapissa	there in fridge (11)	P OTH
toisianne	each other (10)	LEX
seksiä	have sex (16)	MST
kasvissyöjä	a vegetarian (15)	DET
voitte	you can (18)	PRN-SUBJ
facebookissa	on facebook (10)	P
lähetin	i sent (12)	PRN-SUBJ
ymmärrätkö	do you understand (11)	AUX PRN-SUBJ
olenko	am i (18)	PRN-SUBJ
varmistaa	make sure (12)	LEX
kenkäni	my shoes (13)	PRN-POSS
tyttöystäväni	my girlfriend (10)	PRN-POSS
hitaammin	more slowly (13)	DEG
tatoebassa	on tatoeba (14)	P
ostit	did you buy (16)	AUX PRN-SUBJ
ostit	did buy (10)	AUX
keittiössä	in kitchen (25)	P
juon	i drink (12)	PRN-SUBJ
tiesitkö	did you know (17)	AUX PRN-SUBJ
lattialla	on floor (11)	P
tuoksusta	smell of pine trees (14)	MST

Source	Target (count)	Annonation
saitko	did you get (13)	AUX PRN-SUBJ
laitoin	i put (10)	PRN-SUBJ
saksassa	in germany (30)	P
sanoiko	did say (12)	AUX
käytätkö	do you (10)	AUX
tarvitsetko	do you need (19)	AUX PRN-SUBJ
vankilassa	in prison (21)	P
vankilassa	in jail (10)	P
huvittanut	feel like (12)	P
tietääkö	does know (18)	AUX
mustista	like black (11)	MST
tarkoitan	i mean (10)	PRN-SUBJ
valehtelee	is lying (15)	COP-ING
haluavan	will want (32)	AUX
kuulostat	you sound (12)	PRN-SUBJ
olitko	were you (13)	AUX
bostonissa	in boston (219)	P
bostonista	from boston (14)	P
bostonista	in boston (10)	P
mitäköhän	i wonder what (14)	LEX
marilta	from mary (10)	P
huoneeseensa	his room (16)	PRN-POSS
tapahtuisi	would happen (12)	AUX
pystynkö	whether i can (48)	WH PRN-SUBJ
toisemme	each other (12)	LEX
miksette	why don 't (11)	WH AUX
korvasta	out of sow 's ear (12)	MST
vanhempiensa	his parents (11)	PRN-POSS
innolla	looking forward (16)	LEX
saksaksi	in german (14)	P
halusit	you wanted (10)	PRN-SUBJ
yöpyi	stayed at (11)	P
hukkasin	i lost (12)	PRN-SUBJ
puolestani	for me (19)	P
vaikeuksissa	in trouble (25)	P
tunnet	you know (10)	PRN-SUBJ
toiminut	didn work (18)	AUX
puhelimeni	my phone (12)	PRN-POSS
vierailustasi	your stay (11)	PRN-POSS
pahalla	in bad (11)	P
huonolla	in bad (14)	P
typeryyksiä	stupid things (10)	LEX
toisilleen	each other (19)	LEX
sääntöjä	the rules (19)	DET
tietokoneeni	my computer (13)	PRN-POSS
puhuuko	does speak (14)	AUX
maapähkinöille	to peanuts (11)	P
ranskani	my french (12)	PRN-POSS
ylpeitä	proud of (12)	P
lokakuussa	in october (13)	P
aikuinen	an adult (10)	DET
haluttaa	feel like (13)	LEX
vierailustanne	your stay (11)	PRN-POSS
kolmesti	three times (16)	LEX
jollette	unless you (12)	PRN-SUBJ
kirsikkapuun	cherry tree (12)	COM
astrologiaan	in astrology (23)	P
kuorossa	in choir (43)	P
neliöjuuri	square root of (28)	COM P
tähtitieteestä	about astronomy (32)	P
katsokaa	look at (10)	P
lähtemistä	thinking about going (34)	MST
perjantaille	on friday (12)	P

Table A.8: Finnish-English unit shifts (8/9).

Source	Target (count)	Annonation
ellei	unless you (12)	PRN-SUBJ
tiehen	on road (66)	P
samankokoisiin	into equal (18)	P
taksiin	in taxi (16)	P
sini-	functions sine (60)	MST
väliltä	1 ((12)	MST
väliltä	1 (-1 and 1 (12)	MST
alkuluku	prime number (12)	COM
haudalla	's grave (12)	MST
kiinnostaako	are interested (11)	COP-PASS
yhteinen	least common (30)	OTH
yhteenlaskua	two fractions together (10)	LEX
murtolukuja	two fractions (20)	MST

Source	Target (count)	Annonation
tommi-nimisestä	of of (12)	MST
runoilijasta	poet by name tom (12)	MST
ihailematta	but admire (12)	OTH
nuijalla	with mallet (15)	P
varttia	at quarter (10)	P
neljäsosan	quarter of (11)	P
pihta	fir tree (26)	LEX
vanhemman	and elder (12)	CNN
vesirokko	chicken pox (13)	COM
ulkoministeri	foreign minister (10)	COM
pääministerin	prime minister (32)	COM
avainasemaan	key position (16)	COM
tähdistäennustamiseen	in astrology (19)	P

Table A.9: Finnish-English unit shifts (9/9).

Source	Target (count)	Annonation
before	ennen kuin (168)	LEX
kilometers	kilometrin päässä (16)	MST
rid	päästä eroon (12)	LEX
york	new yorkissa (12)	MST
mood	hyvällä tuulella (13)	MST
apologize	pyytää anteeksi (19)	LEX
instead	sen sijaan (14)	LEX
afford	ole varaa (17)	LEX
recently	viime aikoina (32)	LEX
actually	itse asiassa (36)	LEX
busy	kova kiire (11)	LEX
values	arvoja lukujen (34)	MST
lose	tulemme häviämään (16)	MST
equal	yhtä suuri kuin (16)	LEX
red-handed	kiinni rysän päältä (19)	LEX
red-handed	kiinni itse teossa (15)	LEX
red-handed	kiinni housut kintuissa (10)	LEX
bloom	täydessä kukassa (11)	LEX
cooking	laittaa ruokaa (12)	LEX

Source	Target (count)	Annonation
letters	kirjeitä jotka (16)	REL
partially	osittain järjestetty (14)	MST
lines	rivien välistä (11)	MST
sex	harrastaa seksiä (12)	MST
fucking	ihan vitun (16)	OTH
owe	olet velkaa (15)	LEX
owe	olen velkaa (10)	LEX
anyway	joka tapauksessa (11)	LEX
weren	et ollut (15)	NEG-V
weren	ettet ollut (10)	NEG-V CMP
(2013)	vuonna 2013 (15)	MST
quarter	varttia vaille (14)	MST
equals	on yhtä suuri kuin (12)	LEX
equals	on yhtäsuuri kuin (11)	LEX
choir	siinä kuorossa (26)	DET
-1	miinus yksi (34)	NUM
-1	miinus yhden (18)	NUM
fractions	laskette murtolukuja (10)	MST

Table A.10: English-Finnish unit shifts (1/2).

Source	Target (count)	Annonation
i	minä en (48)	MST
muiriel	nyt muiriel (13)	MST
never	ei koskaan (236)	LEX
never	ole koskaan (155)	MST
never	ei ikinä (62)	LEX
never	en koskaan (33)	LEX
never	ole ikinä (28)	MST
never	älä koskaan (19)	LEX
never	en ikinä (18)	LEX
never	koskaan ole (17)	MST
never	eivät koskaan (14)	LEX
'll	et saa (73)	MST
'll	ette saa (60)	MST
'll	sitä saa (36)	EXP
'll	ette saa ette (12)	MST
not	ei ole (629)	COP-NEG
not	ei ollut (37)	COP-NEG
not	eivät ole (24)	COP-NEG
not	en ole (11)	COP-NEG
miss	on ikävä (14)	LEX
another	vielä yksi (10)	LEX
most	suurin osa (24)	LEX
think	luulen että (190)	CMP
think	usko että (76)	CMP
think	sitä mieltä (20)	LEX
think	luulet että (13)	CMP
think	uskon että (11)	CMP
sure	varma että (110)	CMP
sure	varma siitä (19)	PRN-COMP
hurry	pidä kiirettä (14)	LEX
everything	kaikki mitä (26)	REL
could	olisi voinut (14)	AUX
ask	kysyä sinulta (18)	LEX
long	pitkäksi aikaa (15)	LEX
didn	ei ollut (12)	NEG-V
wish	voi kunpa (44)	LEX
wish	toivon että (24)	CMP
anything	mitä tahansa (36)	LEX
anything	mikä tahansa (10)	LEX
wasn	ei ollut (188)	NEG-V
shouldn	ei pitäisi (66)	NEG-V
shouldn	ei olisi (29)	NEG-V
nothing	ei ole mitään (54)	LEX
nothing	ei mitään (26)	LEX
nothing	mikään ei ole (21)	LEX
nothing	mikään ei (19)	LEX
nothing	mitään ei (16)	LEX
nothing	ole mitään (14)	MST
things	asioita joita (11)	REL
no	ei ole (437)	COP-NEG
no	kukaan ei (121)	OTH
no	ei ollut (73)	COP-NEG
idea	mitään käsitystä siitä (11)	DET PRN-COMP
until	kuin vasta (22)	LEX
until	ennen kuin (10)	LEX
poet	tommi-nimisestä runoilijasta (12)	MST
after	sen jälkeen kun (17)	PRN-POSS CMP
tv	tv : tä (36)	PCT
tv	tv : ssä (13)	PCT
we	me emme (21)	MST
please	ole hyvä ja (23)	LEX
please	ole hyvä (21)	LEX
please	ole kiltti ja (19)	LEX

Source	Target (count)	Annonation
please	olkaa hyvä ja (11)	LEX
as	niin kuin (36)	LEX
talk	puhua kanssasi (10)	LEX
tonight	tänä iltana (88)	LEX
tonight	tänä yönä (14)	LEX
getting	alkaa tulla (14)	LEX
years	vuoden ajan (31)	LEX
car	auton alle (14)	MST
marry	mennä naimisiin (11)	LEX
isn	ei ole (432)	NEG-V
isn	eikö olekin (39)	NEG-V
isn	eikö ole (17)	NEG-V
moment	tällä hetkellä (11)	MST
while	sillä aikaa kun (13)	LEX CMP
while	kun taas (11)	LEX
while	silloin kun (11)	LEX CMP
any	milloin tahansa (10)	MST
exist	ole olemassa (11)	LEX
convinced	vakuuttunut siitä (12)	PRN-COMP
first	ensimmäinen kerta (28)	MST
thought	luulin että (101)	CMP
thought	ajattelin että (35)	CMP
thought	luuli että (13)	CMP
thought	ajatteli että (12)	CMP
agree	samaa mieltä (30)	LEX
seems	vaikuttaa siltä (23)	PRN-COMP
seems	näyttää siltä (10)	PRN-COMP
work	tehdä töitä (52)	LEX
work	teen töitä (10)	LEX
couldn	olisi voinut (11)	AUX
someday	jonain päivänä (10)	LEX
aren	eivät ole (38)	NEG-V
aren	et ole (19)	NEG-V
hard	kovasti töitä (15)	MST
us	meidän kanssamme (25)	MST
off	pois päältä (20)	LEX
fact	itse asiassa (12)	MST
twice	kaksi kertaa (24)	LEX
none	ei kuulu (10)	MST
glad	iloinen siitä (19)	PRN-COMP
glad	iloinen että (17)	CMP
wherever	mihin ikinä (10)	LEX
cake	kakkua jos maistuu (10)	MST
whether	että pystynkö (25)	MST
hope	toivon että (77)	CMP
cannot	ei voi (33)	NEG-V
cannot	ei pysty (11)	NEG-V
afternoon	tänään iltapäivällä (24)	MST
hasn	ei ole (71)	NEG-V
forgive	anna anteeksi (11)	LEX
feel	tekee mieli (36)	LEX
feel	tee mieli (29)	LEX
feel	tunnen oloni (18)	LEX
feel	tunnen itseni (15)	LEX
feel	minua haluttaa (13)	LEX
lately	viime aikoina (23)	LEX
nobody	kukaan ei (122)	NEG-V
mention	vaan myös (11)	MST
used	oli tapana (25)	LEX
used	oli ennen (13)	LEX
working	toimi enää (20)	OTH
working	tekee töitä (10)	LEX
whatever	mitä tahansa (10)	LEX

Table A.11: English-Finnish unit shifts (2/2).

Source	Target (count)	Annonation
back soon	pian takaisin (13)	ADV-ADV
won 't	ei tule (31)	AUX-NEG
with me	minun kanssani (20)	P-PRON
just wanted	halusin vain (16)	ADV-V
can 't	ei voi (105)	AUX-NEG
can 't	etkö voi (14)	AUX-NEG
can 't	ei osaa (56)	AUX-NEG
can 't	ei pysty (22)	AUX-NEG
can 't	ette voi (29)	AUX-NEG
can 't	et voi (26)	AUX-NEG
is today	tänään on (19)	COP-ADV
hot today	tänään kuuma (12)	ADJ-ADV
are you	sinä olet (32)	COP-PRON
are you	te olette (11)	COP-PRON
is it	se on (27)	COP-PRON
with him	hänen kanssaan (44)	P-PRON
is your	sinun on (20)	COP-PRON
between and	ja välillä (24)	P-CONJ
with you	sinun kanssasi (31)	P-PRON
should i	minun pitäisi (21)	AUX-PRON
don 't	ei ole (48)	AUX-NEG
going here	täällä tapahtuu (12)	V-ADV
go now	nyt lähteä (13)	V-ADV
go now	nyt mennä (10)	V-ADV
with tom	tomin kanssa (158)	P-N
didn 't	ei ollut (33)	AUX-NEG
didn 't	ei tehnyt (18)	AUX-NEG
could not	ei voinut (29)	AUX-NEG
is he	hän on (11)	COP-PRON
don think	minusta ole (11)	MST
't think	minusta ei (17)	MST
is tom	tom on (13)	COP-N
is tom	tomi on (15)	COP-N
with them	heidän kanssaan (13)	P-PRON
is that	tuo on (20)	COP-PRON
couldn 't	ei pystynyt (36)	AUX-NEG
couldn 't	ei voinut (53)	AUX-NEG
couldn 't	ei saanut (17)	AUX-NEG
is this	tämä on (47)	COP-PRON
't this	tämä ei (11)	NEG-PRON
are this	tässä on (15)	AUX-PRON
's that	tuo on (12)	COP-PRON
am i	minä olen (14)	COP-PRON
end month	kuun lopussa (10)	N-N
's today	tänään on (33)	COP-ADV
cold today	tänään kylmä (13)	ADJ-ADV
after school	koulun jälkeen (20)	P-N
't it	se ei (13)	NEG-PRON
after lunch	lounaan jälkeen (15)	P-N
with her	hänen kanssaan (31)	P-PRON
haven 't	ei ole (12)	AUX-NEG

Source	Target (count)	Annonation
spoken yet	vielä puhunut (13)	V-ADV
me yet	vielä minulle (17)	PRON-ADV
only speak	puhun vain (10)	ADV-V
isn 't	ei ole (10)	COP-NEG
you speak	puhutko sinä (12)	PRON-V
" "	" " (12)	MST
" "	” ” (18)	MST
's now	nyt on (10)	COP-ADV
just got	sain juuri (11)	ADV-V
just want	haluan vain (26)	ADV-V
better now	nyt parempi (11)	ADJ-ADV
better now	nyt syytä (10)	ADJ-ADV
can i	minä voin (12)	AUX-PRON
ever again	enää koskaan (17)	ADV-ADV
with mary	marin kanssa (45)	P-N
with mary	maryn kanssa (21)	P-N
he didn	ettei hän (11)	PRON-NEG
's here	täällä on (36)	COP-ADV
happened tom	tomille tapahtui (37)	V-N
happened tom	tomille kävi (12)	V-N
were you	sinä olit (11)	COP-PRON
and and	ja ja (15)	MST
was no	ei olisi (17)	COP-NEG
did you	sinä teit (12)	MST
you know	tiedätkö sinä (21)	PRON-V
do anymore	enää tehdä (41)	V-ADV
that anymore	enää tuota (24)	PRON-ADV
that anymore	enää noin (18)	PRON-ADV
you now	nyt sinun (12)	PRON-ADV
you now	nyt teidän (12)	PRON-ADV
french fluently	sujuvasti ranskaa (11)	N-ADV
home tomorrow	huomenna kotona (11)	N-ADV
good "	” hyvä (12)	MST
if don	älä jos (12)	CONN-AUX
if call	soittaa jos (12)	CONN-V
want anybody	ketään halua (11)	V-PRON
never unless	saa koskaan (12)	MST
never unless	saa ikinä (12)	MST
know unless	saa tietää (30)	MST
one left	jäljellä yksi (14)	NUM-ADV
sine and	ja ottavat (30)	MST
sine and	ja saavuttavat (30)	MST
sine cosine	kosinifunktiot ottavat (30)	MST
sine cosine	kosinifunktiot saavuttavat (30)	MST
and included	mukaanlukien ja (12)	ADV-CONJ
if me	minulle jos (12)	CONN-PRON
if forget	unohda jos (12)	CONN-V
you 't	ette te (11)	PRON-NEG
'd now	nyt olisi (13)	COP-ADV
can anymore	enää voi (24)	AUX-ADV
stopped working	meni rikki (12)	MST

Table A.12: Word-order shifts.