ELEMENTS
of
CLAUSAL EMBEDDING

Patrick D. Elliott

Doctor of Philosophy

UCL

DECLARATION

I, Patrick David Elliott confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis

Cambridge, January 2020

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Patrick D. Elliott

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'…*es gibt aber nichts Glücklicheres als die Arbeit, und Liebe, gerade weil sie das äußerste Glück ist, kann nichts anderes als Arbeit sein.*'

— Rainer Maria Rilke, letter to Friedrich Westhoff, 29 April 1904

ABSTRACT

This thesis asks: what is the division of labour between the syntax and the semantics? The empirical focus is on the phenomenon of clausal embedding, whereby the grammar provides the resources to embed a clause within another clause, and the semantics provides the resources to represent an individual's mental representations. The primary goal is to argue that *that*-clauses denote predicates of contentful entities – abstract objects, such as propositions, facts, and rumours. The major theoretical claim is that *that*-clauses function quite generally as modifiers in the compositional semantics, both when they compose with nominals and verbs. In order to cash this idea out, a strictly neo-Davidsonian approach to the syntax-semantics interface is outlined. In the syntax, arguments are severed from the verb; rather, they are incorporated as specifiers of functional heads. This is paralleled by a neo-Davidsonian semantics, where verbs denote predicates of eventualities, and thematic arguments are incorporated via metalanguage functions. Consequently all verbs, including attitude verbs, are argued to simply denote predicates of eventualities. Embedded clauses compose with attitude verbs as intersective modifiers – they specify the content of the verb's eventuality argument.

IMPACT STATEMENT

This thesis develops a novel way of analyzing clausal embedding within the framework of *event semantics*. As such, it represents an important stepping stone for synthesising two foundational areas in formal semantics, research in which has proceeded thus far in a largely modular fashion. Ultimately, if the analysis here is proceeding in the right direction, and embedded clauses should indeed be properly treated as *modifiers*, it will ultimately have important implications for more structural approaches to speech and language processing, as well as potentially for the analysis of syntacto-semantic deficits in the area of speech & language therapy.

ACKNOWLEDGMENTS

Over the course of this PhD, I've been through at least ten different apartments - maybe more, I've lost track at this point - moved countries a couple of times, entertained and discarded thousands of wild ideas and too many putative dissertation topics (sorry Klaus!), and spent countless sleepless nights wondering what the hell it is that I've decided to spent four years of my life on. It may be a cliché, but I really do feel like a completely different person to the fresh-faced twenty-four-year-old starting as a brand new baby graduate student at Chandler House back in 2013.

Before acknowledging some actual humans, It'd be remiss of me not to talk about Chandler House, which sometimes feels like the only real home I've had since moving out of my parents' place. UCL's linguistics department was originally based in a tiny Georgian townhouse on the main Gower Street campus, and it was there that Professor Xi Yu interviewed me - this was back when UCL still did interviews - for a place on the Linguistics BA programme. The year I began my time as a UCL undergraduate was the year that the linguistics department moved into Chandler House, and I've been there ever since. I've spent almost seven years of my life there, interrupted only by year-long stints in Tübingen and Edinburgh. Having moved at least once per year (thanks to exorbitant London rents, and a variety of other factors), I can't emphasise how important Chandler House has been as a constant, and I'm sure that everyone I've shared an office with over the last few years will attest to the fact that my desk has an extremely *lived-in* feel to it. It's a testament to my PhD family that they've tolerated my various eccentricities with good humour over the last few years; in this guise especially, I'm grateful to the old guard: Ye Tian, Jonny McIntosh, Harris Constantinou, Kevin Tang, and Matthew Gotham; the lovely Italians: Giulio

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Amongst everyone who I mention here, the person who I probably owe the most gratitude is my primary supervisor, Klaus Abels, who has without a doubt been the best kind of role model, both intellectually, but also in terms of the kind of person I'd like to grow up to be. Klaus was my first syntax teacher, and I still remember vividly the insane levels of energy and excitement he injected into our undergraduate syntax classes, which were always my favourite. I have endless respect for the rigour with which he approaches so many aspects of intellectual life, and since those first undergraduate classes I feel like i've been struggling to live up to those lofty standards.

I'm also immensely grateful to Yasu Sudo, who hasn't just been an exemplary secondary supervisor, but also a whip-smart collaborator, drinking buddy, and confidante. I'm so glad that Yasu chose to take up a position at UCL just as I was starting here as a grad student, and he has in large part been responsible for a gradual shift in my research interests towards semantics over the last few years.

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how to think analytically, and Ad Neeleman, who, in his capacity as head of department offered invaluable financial aid, which facilitated summer school and conference trips which had a huge effect on my intellectual growth. Thanks also to Robyn Carston, Richard Breheny, and Annabel Cormack, for contributing to an incredibly stimulating environment in which to be a researcher. One of my few regrets from this period is not taking better advantage of all of the gifted thinkers surrounding me.

Outside of UCL, there are so many academics who have played an incredibly important role in my development, either directly or indirectly. From my time at Edinburgh, I'd especially like to thank Gary Thoms, who played an invaluable role in teaching me how to actually do good research, and helped me find the confidence to put myself out there. I'd also like to thank Peter Ackema, Caroline Heycock, and Nik Gisborne specifically, all of whom contributed in important ways to a year which I'll always look back on with great fondness.

A fairly recent development is that the Leibniz-Zentrum für Allgemeine Sprachwissenschaft in Berlin has became a linguistic home-away-from-home, and I can't wait to spend more time there in the future. First and foremost, I'm grateful to Andreea Nicolae, who was in the first place the reason that I considered visiting ZAS at all, which turned out to be an incredibly fortuitous decision, professionally and personally. Andreea has been endlessly patient and supportive and generally an excellent friend. I'd also like to thank Uli Sauerland, who has went above and beyond the call of duty in making me feel welcome, and whose continual support I am incredibly thankful for. Thanks also to everyone else at ZAS who makes it such a great environment, especially Marie Christine-Meyer, Werner Frey, Berit Gehrke, Hadil Karawani, Clemens Mayr, Tom McFadden, Guillermo del Pinal, Stefanie Solt (and Snuffles, of course!), Hubert Truckenbrodt, Kazuko Yatsushiro and finally Brandon Waldon, who possesses the incredibly annoying combination of talent *and* youth, and is going to go on to do *great* things at Stanford.

Finally, I'm grateful most of all to my parents, Helen and Ian, and my brother and sister, Simon and Lucy, who provide the necessary and irrevocable foundation on top of which everything I accomplish is built.

CONTENTS

TYPOGRAPHICAL CONVENTIONS

TYPES

Types are typeset in a sans-serif typeface: t, ⟨et, t⟩, etc.

TYPE VARIABLES

Type variables are typeset as sans-serif small Greek letters: σ, τ, etc.

METALANGUAGE EXPRESSIONS

Predicates and individual constants in the metalanguage are typeset in a sans-serif typeface, in order to distinguish them from expressions in the object language: John, hugs, dog, etc.

VARIABLES

Variables over members of typed domains are typeset as as upright serif roman letters: x, y, z, etc.

THEMATIC ROLES

Thematic functions in the metalanguage are typeset as swashed caps: $\mathcal{AG}$ (*agent*), $\mathcal{TH}$ (*theme*), $\mathcal{EXP}$ (*experiencer*), etc.

ROOTS

Roots are typeset in a serif typeface and enclosed in a long square root: $\sqrt{\text{dog}}$, $\sqrt{\text{house}}$, $\sqrt{\text{happy}}$, etc.

ACRONYMS

CEN   Complex Event Nominal

CONTDP Content DP

CP-SM CP-Subject-Matter

CP-C CP-Causer

CR Conjunction Reduction

DM Distributed Morphology

EN Event Nominal

FA Functional Application

ITV Intensional Transitive Verb

LF Logical Form

MP! Maximize Presupposition!

NCC Noun Complement Clause

PA Predicate Abstraction

PF Phonological Form

PM Predicate Modification

PROPDP Propositional DP

P-TO-Q Proposition-to-Question Reduction

Q-TO-P Question-to-Propostion Reduction

RN Result Nominal

SEN Simple Event Nominal

URR Unique Role Requirement

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INTRODUCTION

THE BIG QUESTION that this thesis is concerned with is as follows: *what is the division of labour between syntax and the semantics?*. The empirical focus is on the phenomenon of *clausal embedding*, whereby the syntax provides the resources to embed a clause within another clause *ad infinitum*, and the semantics provides the resources to talk about an individual's *beliefs*, *hopes*, and *fears*.

The conclusions here are notable, in that far more emphasis is placed on the *semantic* component determining embedding possibilities, than in many other existing studies of clausal embedding in generative linguistics (the *locus classicus* being Stowell 1981). The picture that emerges is of a fairly unconstrained syntactic component, the primary job of which is to build structured representations from syntactic formatives (*roots* and feature bundles, in the Distributed Morphology framework assumed here). Constraints on clausal embedding which were previously thought to be the within the purview of syntax are instead explained as a reflex of independently needed constraints on semantic composition, or indeed constraints on the logical representations that are the result of semantic computation.

One of the primary goals of this work is to argue that *that*-clauses denote predicates of type $\langle e, t \rangle$, ranging over contentful entities – abstract objects, such as those discussed under the guise of *propositons*, *facts*, *rumours*, and *stories*. This perspective was first advanced by Kratzer (2006), and subsequently developed by Hacquard (2006), Moulton (2010, 2009, 2015), and others. It goes without saying that this thesis owes a major intellectual debt to the aforementioned thinkers.

"Endings are elusive, middles are nowhere to be found, but worst of all is to begin, to begin, to begin."

— *The Dolt,* Donald Barthelme

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The major theoretical claim advanced in this thesis is that embedded clauses are *modifiers*. A parallel is drawn here between adverbial modifiers, such as *sloppily* in sentences such as (1), and embedded clauses in sentences such as (2). Davidson (1967) famously claimed that sentences involving action verbs should be represented as existential statements about eventualities, as in (1b), although the specifics of Davidson's proposal differ from the logical representation given in (1b). (1b) says, in plain English, that there is a *buttering* event by Josie, of the toast, and it is a *sloppy* buttering event. The adverb *sloppily* therefore modifies the event argument of *butter*. I will argue that sentences involving clausal embedding, such as (2a), should receive a similar analysis. The logical representation in (2b) says, in plain English, that there is a *saying* event by Josie, and the *content* of the saying event if *Nathan is angry*. The *that*-clause therefore modifies the event argument of *say*, specifying its *content*. This is a major departure from the logical representations that most linguists assume for sentences involving clausal-embedding, which following Hintikka (1969), generally involve quantification over possible worlds.

(1) a. Josie buttered the toast sloppily.

   b. $\exists e \begin{bmatrix} \mathcal{AG}(e) = \text{Josie} \\ \wedge\ \mathcal{TH}(e) = \text{theToast} \\ \wedge\ \text{buttering}(e) \\ \wedge\ \text{sloppy}(e) \end{bmatrix}$

(2) a. Josie said that Nathan is angry.

   b. $\exists e \begin{bmatrix} \mathcal{AG}(e) = \text{Josie} \\ \wedge\ \text{saying}(e) \\ \wedge\ \mathcal{CONT}(e) = \text{Nathan is angry} \end{bmatrix}$

I will argue that a satisfactory treatment of clausal embedding requires specific assumptions to be made concerning the syntax and semantics.

As reflected in the logical representations in (1b) and (2b), it will be important that logical representations are *neo-Davidsonian* in nature (Castañeda 1967, Parsons 1990); that is to say that arguments are incorporated into the logical representation via thematic functions in the meta-language. Furthermore, I will argue that neo-Davidsonian logical representations are paralleled in the syntax, in the sense that all arguments are severed from the verb (following, e. g. Lohndal 2014), and must be incorporated into the syntactic representation via distinct functional heads. This parallel between the syntax and semantics with respect to the seperability of arguments will play a crucial role in the account of clausal embedding laid out here, and therefore to the extent that this account is successful, it can be considered an argument for the kind of neo-Davidsonian syntax-semantics interface developed here.

The organization of the thesis as a whole is as follows: in this, the introductory chapter (ch. 1), I lay the formal groundwork and establish the theoretical foundations upon which the remainder of the thesis rests. Ch. 2, the heart of the thesis, is devoted to a thorough explication of *that*-clause embedding within a neo-Davidsonian framework. In ch. 3, I will extend the analysis of embedded *that*-clauses to embedded interrogatives. In ch. 4, I will briefly show how the analysis of embedded clauses as modifiers can be reconciled with Hintikka's (1969) treatment of attitude verbs as quantifiers over possible worlds. In ch. 5, which is largely speculative, I will sketch some consequences of the system developed here for clauses in subject position, and related phenomena. Finally, in ch. 6, I conclude with open questions and issues to be addressed in future work.

Zooming back in, the organization of this chapter is as follows: I will begin by establishing some necessary theoretical foundations assumptions I adopt concerning the architecture of the grammar - specifically, I will commit to a Distributed Morphology (DM) architecture. This is partially for ease of exposition, but I will make significant use of mechanisms in DM proposed to account for *contextual allosemy* in subsequent

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chapters. In §1.2, I outline the background assumptions I make concerning the place of *semantics* in generative linguistics. In section §1.3, I introduce the notion of an *eventuality*, which will play a substantial role in this thesis, and go on to lay out a concrete syntax-semantics interface based on a compositional neo-Davidsonian event semantics. In §1.4, I summarize some arguments given in the literature for neo-Davidsonian logical representations, independent from the data considered here. I concentrate primarily on the case of *out*-prefixation in English, building on work by Ahn (2015,2016). In §1.5, I address how to relate events and worlds, and I will argue that there is no meaningful different between eventualities and other entities in this respect.

1.1 DISTRIBUTED MORPHOLOGY

I assume a Distributed Morphology (DM) architecture (see Halle & Marantz 1993, Harley & Noyer 1999, Nevins 2016 for general overviews). This ground is extremely well-trodden, so I will only give a brief overview of the core assumptions of DM, highlighting features which will play a theoretically important role in this thesis.

DM builds on a classic, so-called Y-model of the grammar, according to which the narrow syntax feeds two interfaces: Phonological Form (PF) and Logical Form (LF). The basic units of syntactic computation are bundles of syntactic features, and *roots* (Harley's 2014 *List 1*), which are assembled into hierarchical structures via successive applications of the operation MERGE (Chomsky 1995). At some point over the course of the derivation, the resulting syntactic representation is sent off to PF and LF in an operation known as *Spell-Out*.[1]

On the PF side, morphological operations may re-arrange the terminal nodes in various ways (this will not really concern us here), and subsequently the list of VOCABULARY ITEMS (Harley's *List 2*) is accessed in

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1 Spell-Out is usually assumed to take place in a cyclic fashion, although the exact conditions under which Spell-Out takes place are currently an area of active research.

an operation known as *Vocabulary Insertion*. Vocabulary items are correspondence rules[2] for relating syntactic representations (feature bundles and roots) to phonological representations in context. Since correspondence rules may be conditionalised to the input's local environment, they compete according to the *Subset Principle* (Halle 2000).

On the LF side, the ENCYCLOPAEDIA is accessed (Harley's *List 3*). The encyclopaedia is a set of correspondence rules relating syntactic representations (feature bundles and roots) to semantic representations (expressions in the metalanguage), in context. Much like on the PF side of the derivation, these correspondence rules may be conditionalised to the input's local environment, and are therefore assumed to compete in accordance with the *Subset Principle.*

One of the core properties of DM which distinguishes it from other architectures (specifically lexicalist architectures) is *Late Insertion*. In DM, it is assumed that the phonological realisation of syntactic terminals as *Vocabulary Items* does not take place until the output of the narrow syntax is shipped off to PF; the atomic units of syntactic computation are abstract, and have no inherent phonological realization. An illustration of the DM architecture is given in (3).

(3)

$$\left\{ ... \, n, v, [\, \text{SG}\,], \sqrt{\text{dog}}, \sqrt{\text{swim}}, ... \right\}$$

⇐ syntactic operations

Spell-Out

morphological operations ⇒

PF

LF

consult VOCABULARY ITEMS (List 2)   consult ENCYCLOPAEDIA (List 3)

---
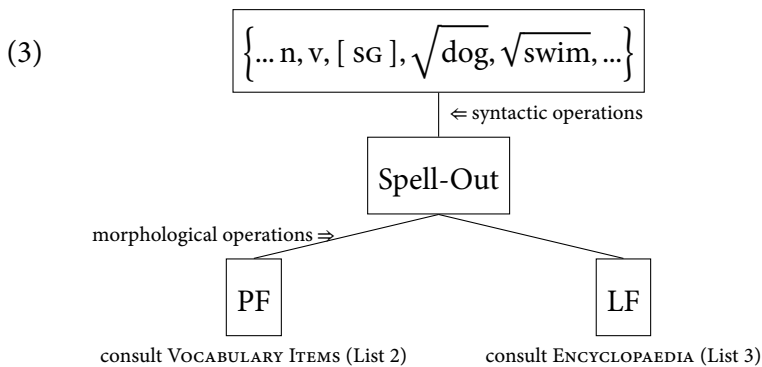
2 An alternative formalism in DM treats Vocabulary Items as rewrite rules rather than correspondence rules (i. e. '→' is used rather than '↔' in the rule schema. There are substantive differences between the two formalisms, such as whether the featural content of terminals subject to spellout remains visible and may condition subsequent vocabulary insertion, but these questions will not concern us here. See Jonathan Bobaljik 2000 for discussion.

In DM it is generally assumed that the spell-out of syntactic terminals can be conditioned by their environment in which they appear. Marantz (2013) gives the example of $\sqrt{house}$ which is subject to both contextual allomorphy *and* contextual allosemy. The contrast in (4) is a consequence of contextual allomorphy conditioned by the categorizer with which $\sqrt{house}$ is merged. The contrast in (5) is a consequence of contextual allosemy triggered by the categorizer with which $\sqrt{house}$ is merged. Marantz observes that the verb *to house* does not entail the existence of a house per se, but means something like *to contain*.[3]

(4) $\sqrt{house} \leftrightarrow$ /haus/ / [n ___]

   $\leftrightarrow$ /hauz/ / [v ___]

(5) $\sqrt{house} \leftrightarrow \lambda x . \text{house}(x)$ / [n ___]

   $\leftrightarrow \lambda e . \text{contain}(e)$ / [v ___]

Marantz observes that it is also possible to use *house* as a verb without voicing the word-final fricative, in which case the interpretation seems to be along the lines of: *do something with houses*. Marantz gives the example in (6). The interpretation in the absence of allomorphy then, is predictable on the basis of the meaning of the nominalized root. This suggests that the structure for the verb *to house* in (6) is as in (7).

(6) He took a bunch of plastic models and housed the room in revenge.
   ↝ *filled the room with the houses*

This suggests that contextual allosemy is strictly *local*. The spellout of $\sqrt{house}$ is insensitive to the presence of v due to the presence of an intervening n (see the syntactic representation in (7)). Contextual allosemy will at times play an important role in this thesis. It is important to note

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3 I assume that the meaning of the verb *to house* is simply a predicate over eventualities, in line with neo-Davidsonian event semantics. I elaborate on the semantic assumptions made here in section §1.3. Ultimately I will claim that root meanings are quite generally (one-place) predicates, following, e. g., Levinson (2010), and contra, e. g. Harley (2014).

that not just roots, but also functional heads (which in DM, are understood to be syntactic feature bundles) can be subject to contextual allomorphy/allosemy; see e. g. Wood & Marantz 2017 for discussion.

(7)

```
            v
           / \
          /   \
         v     n
              / \
             /   \
            n    √house
```
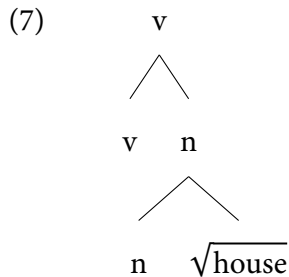
1.2 SEMANTICS

Following much work in linguistic semantics in the generative tradition (see, e. g., Heim & Kratzer 1998, Jacobson 2014 for overviews), I assume an *interpretive* semantics, operating on the output of the narrow syntax (LF). According to this tradition in linguistic semantics, specifying a semantics for natural language involves specifying a recursive procedure whereby syntactic representations are translated into expressions in the meta-language. For the meta-language, I use a formal language similar to Gallin's (1975) Ty2, in concert with certain set-theoretic notions where appropriate. Expressions of the meta-language are interpreted relative to a Model M consisting of a domain D of individuals; E of eventualities; W of possible worlds; an assignment function g, and an interpretation function $[\![.]\!]$, that maps expressions of the meta-language to the model-theoretic interpretations (this is laid out in (8)).

(8) **Definition: model**
A model is a tuple $M = \langle D, E, W, [\![.]\!], g \rangle$

  a. D: the non-empty set of individuals

  b. E: the non-empty set of eventualities

c. *W*: the non-empty set of possible worlds

d. *g*: an assignment function

e. $[\![.]\!]$: the interpretation function

The translation procedure therefore technically involves two steps: (i) the translation from a syntactic representation (LF) to an expression in the metalanguage, and (ii) the translation from an expression in the metalanguage to a model-theoretic interpretation. I will often abstract away from this two-step process however, and sometimes talk about semantic values as expressions in the metalanguage, and sometimes as model-theoretic interpretations, where contextually appropriate. As such, I deliberately use the same notation $[\![.]\!]$ for both the function that takes a syntactic representation as its input and returns a metalanguage expression, and the function that takes a metalanguage expression as its input and returns a model-theoretic interpretation, despite the fact that these two functions are technically distinct.

1.2.1 *Semantic types*

Metalanguage expressions are categorized in terms of TYPES. I assume that the primitive types, as given in (9), consist of a type e for entities, t for the type of truth values, and type s for the type of possible worlds. The complete inventory of semantic types is characterized intensionally in (10).

(9) **Definition: primitive types**
   $\mathtt{type_0} = \{e, t, s\}$

(10) **Definition: types**
   The set of semantic types is the smallest set $\mathtt{type}$ containing $\mathtt{type_0}$
   which satisfies for every $\sigma_1, \sigma_2 \in \mathtt{type} : \langle \sigma_1, \sigma_2 \rangle \in \mathtt{type}$

Each semantic type in type specifies a typed-domain, as defined in (11).

(11) **Definition: typed domains**

    a. $D_e = D \cup E$

    b. $D_s = W$

    c. $D_t = \{0, 1\}$

    d.   If $\sigma_1, \sigma_2 \in$ type

        then $D_{\langle \sigma_1, \sigma_2 \rangle} =$ the set of functions from D_{σ_1} to D_{σ_2}.

Note especially that I take D_e to consist of the union of D and E, i. e., a set consisting of all individuals and eventualities in the model. This departs from much existing work in linguistic semantics where eventualities are taken to be part of the model, in that typically a new primitive type v is added to the set of primitive types, and accordingly D_e is taken to be D and D_v is taken to be E. This may seem like a fairly arbitrary technical choicepoint, but will turn out to be important. We'll return to discuss this further in subsequent chapters.

1.2.2 *Composition rules*

There are three rules of semantic composition: Functional Application (FA), Predicate Modification (PM), and Predicate Abstraction (PA), which are defined below for any type σ. The semantic composition rules, provide us with a recursive procedure for computing the meaning the meanings of a non-terminal node α on the basis of its daughters β and γ.[4] The interpretation of non-branching nodes is provided by instructions in the

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4 Note that our semantic composition rules are defined in a brute-force manner such that semantic composition is *non-directional*. It seems to be a quite general fact about natural languages that semantic composition is not sensitive to linear order, so ideally we would like that to follow from deeper properties of the architecture we adopt. The problem here, and the reason we have to impose non-directionality in such a cumbersome manner, is that the syntactic structures which are typically taken to be the input to the

ENCYCLOPAEDIA, and may therefore be relativized to the surrounding environment (I depart from Heim & Kratzer 1998 in this respect, who assume a *lexicalist* architecture).

$$
\left[\!\!\left[
\begin{array}{c}
\alpha \\
\wedge \\
\beta \quad \gamma
\end{array}
\right]\!\!\right]
=
\begin{cases}
\text{FA:} & \\[4pt]
[\![\beta]\!]([\![\gamma]\!]) & [\![\gamma]\!] \in \mathrm{dom}([\![\beta]\!]) \\[4pt]
[\![\gamma]\!]([\![\beta]\!]) & [\![\beta]\!] \in \mathrm{dom}([\![\gamma]\!]) \\[4pt]
\hline
\text{PM:} & \\[4pt]
\lambda a \in D_\sigma \,.\, [\![\beta]\!](a) \wedge [\![\gamma]\!](a) & [\![\beta]\!], [\![\gamma]\!] \in D_{\langle\sigma,t\rangle} \\[4pt]
\hline
\text{PA:} & \\[4pt]
\lambda b \,.\, [\![\gamma]\!]^{g[\beta \to b]} & \beta \text{ is an index} \\[4pt]
\lambda b \,.\, [\![\beta]\!]^{g[\gamma \to b]} & \gamma \text{ is an index}
\end{cases}
$$

I assume that indices are *complex* – specifically, they consist of a numerical index n and a type σ (13).

(13)   **Definition: indices**

An index is an ordered pair $\langle n, \sigma \rangle \in \mathbb{N} \times \texttt{type}$

---

semantic component of the grammar encode too much information - specifically, they encode precedence relations between nodes as well as domination relations.
One way to make non-directionality follow from our architectural assumptions is as follows.

(12) $\textsc{Merge}(\alpha, \beta) = \{\alpha, \beta\}$ Chomsky 2001

FA can be conceived of as a *partial binary operation* defined for a set $\{\alpha, \beta\}$ iff $[\![\beta]\!] \in$ Dom$([\![\alpha]\!])$. If defined FA$(\{\alpha, \beta\}) = [\![\alpha]\!]([\![\beta]\!])$. Since sets are unordered, and sets are the input to FA, it follows directly that FA is non-directional. Likewise for PM and PA. Precedence relations between nodes are subsequently computed, in order to derive a total ordering of terminals for the phonological component of the grammar.

The interpretation of traces and pronouns, which carry indices, is determined by the assignment function *g*. Assignment functions are defined in (14). The rule for interpreting traces and pronouns is given in (15).[5]

(14)   **Definition: assignments**

A function *g* is an *assignment* iff dom(*g*) is the set of indices.

(15)   **Traces and pronouns rule**   (Heim & Kratzer 1998: p. 116)

If α is a pronoun or a trace, *g* is an *assignment*, and *i* is an *index*, then

$[\![\alpha_i]\!]^g = g(i)$

Treating indices as complex objects allows for the possibility of movement leaving behind a trace of a type other than e (see, e. g., Cresti 1995). A simple example of its application to VP fronting is given in (18).[6]

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5 Having a single composition rule PA for dealing with both the binding of traces and the binding of pronominals makes certain problematic predictions such as the availability of *weak crossover* configurations. A fully-fledged account of the syntax-semantics interface will most likely have to make a syntactic distinction between movement indices and binding indices - see Büring 2005 for an overview - but for our purposes it will be relatively harmless to abstract away from this.

6 Note that I follow Heim & Kratzer 1998: pp. 37 in adopting the following notational convention for lambda expressions.

(16)   Read "[$\lambda\alpha : \varphi . \gamma$]" as either (16a) or (16b), whichever makes sense.

   a.   "the function which maps every α such that φ to γ"

   b.   "the function which maps every α such that φ to 1, if γ, and to 0 otherwise.

For illustrate, consider a Russellian denotation for the definite article, given in (17). The lambda expression is to be read as: the function which maps every predicate *P* to the lambda expression labelled as π, i. e., clause (16a) applies. The lambda expression π on the other hand, is to be read as: the function which maps every predicate *Q* to 1, if the metalanguage expression labelled ψ holds, i. e., clause (16b) has applied.

(17) $[\![\text{the}_{\text{Russell}}]\!] = \lambda P . \lambda Q . \overbrace{\underbrace{\exists x[P(x) \wedge \forall y[P(y) \rightarrow x = y] \wedge Q(x)]}_{\pi}}^{\psi}$

(18) Go to the shops, John didn't.

1 iff
$\neg$goToTheShops(John)

$\lambda x\,.\,$goToTheShops(x) $\qquad$ $\lambda P\,.\,\neg P(\text{John})$

VP

$\langle 1, \langle e, t \rangle \rangle$ $\qquad$ 1 iff
$\neg g(1, \langle e, t \rangle)(\text{John})$

go to the shops

John $\qquad$ $\lambda x\,.\,\neg g(1, \langle e, t \rangle)(x)$

John $\quad$ $\lambda P\,.\,\lambda x\,.\,\neg P(x)$ $\quad$ $g(\langle 1, \langle e, t \rangle \rangle)$

didn't $\qquad$ $t_{\langle 1, \langle e, t \rangle \rangle}$
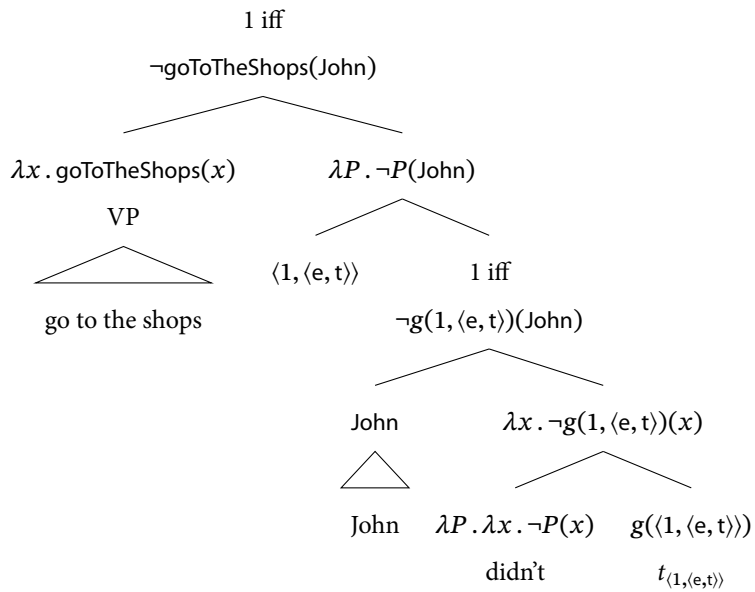
Note that I will often use a lambda operators and matching variables as notational shorthand for indices and co-indexed traces, where this makes sense, as illustrated in the LF (19), which is intended to convey the same information as the LF in (18).

(19) Go to the shops, John didn't.

1 iff ¬goToTheShops(John)

$\lambda x\,.\,\mathsf{goToTheShops}(x)$ $\lambda P\,.\,\neg P(\mathsf{John})$

VP

go to the shops

$\lambda P_{\langle e,t\rangle}$ 1 iff ¬$P(\mathsf{John})$

John $\lambda x\,.\,\neg P(x)$

John $\lambda P\,.\,\lambda x\,.\,\neg P(x)$ P

didn't t_P
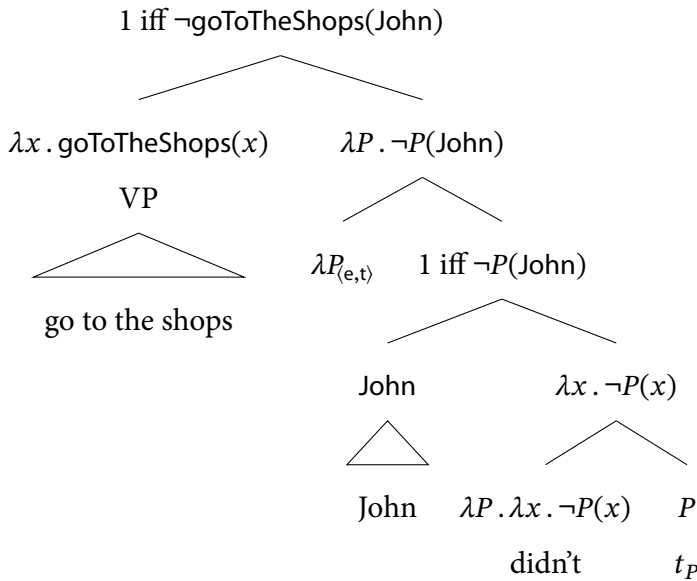
1.2.3 *Presuppositions*

For concreteness, I adopt Heim & Kratzer's (1998) analysis of presuppositional predicates as denoting *partial functions*; the interpretation function ⟦.⟧ is not defined for a sentence S if S's presuppositions are not met. Consequently, presupposition failures are modelled as sentences for which ⟦.⟧ is not defined, and which consequently do not have a truth value. I give a sample denotation for the presuppositional predicate *stop smoking* in (21). Following Heim & Kratzer (1998), the presuppositional component of the meaning of the predicate is written between the colon and the dot, and the assertive component of the meaning of the predicate is written after the dot.[7]

---

7 It is well-established in the relevant theoretical literature that this naive treatment of presuppositions via partial functions is empirically inadaquate, since according to the account outlined here, presuppositions necessarily project to the topmost sentential node. This is however not always the case. Consider, e.g., the example in (20), from Sudo 2012: pp. 43.

(21) $[\![\text{stop smoking}]\!] = \lambda x : \overbrace{x \text{ smoked before}}^{\text{presupposition}} . \underbrace{\neg\text{smoke}(x)}_{\text{assertion}}$

Our formulation of FA needs to be modified slightly in order to accommodate the possibility of presupposition failures, and to ensure that presupposition failures *project*. An illustrative example of how to reformulate FA to ensure presupposition projection is given in (22). The process of revising our semantic composition rules in this way is fairly mechanical, and there is no need to do this explicitly here.

(22)   Revised FA:

$$\left[\!\!\left[\; \begin{array}{c} \alpha \\ \bigwedge \\ \beta \quad \gamma \end{array} \;\right]\!\!\right] \in \text{dom}([\![.]\!]) \text{ iff}$$

   a. $[\![\beta]\!] \in \text{dom}([\![.]\!])$

   b. $[\![\gamma]\!] \in \text{dom}([\![.]\!])$

   c. $[\![\gamma]\!] \in \text{dom}([\![\beta]\!])$

   d.   If defined, $[\![\alpha]\!] = [\![\beta]\!]([\![\gamma]\!])$.

1.2.4   *Intensionality*

The framework I assume for dealing with intensionality is close to the one outlined in Heim & von Fintel 2011: 8.2. Concretely, I assume that the object language includes covert world pronouns. Predicates, such

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(20)   If Rafael is talking about Ubuntu, then he stopped using Mac.

Observe that the sentence as a whole does not presuppose that Rafael used a Mac in the past, but since *stop* is presuppositional, the partial functions account outlined here predicts that it should. There are a number of competing theories of presuppositionality on the market, but for simplicity I will stick to the partial function account, since nothing in this thesis will crucially depend on facts about presupposition projection. See Sudo 2012 for an overview of various alternatives to the partial function account.

as *blue*, may take covert world pronouns as arguments. Free world pronouns are assumed to be bound by a λ-operator, and therefore sentences are taken to denote propositions of type $\langle s, t \rangle$. An example LF for the simple sentence *the chair is blue* is given in (23).[8]

(23)

$$\lambda w \,.\, \text{blue}_w(\iota x[\text{chair}_w(x)])$$

$\langle 0, s \rangle$ 1 iff $\text{blue}_{w_0}(\iota x[\text{chair}_{w_0}(x)])$

$\iota x[\text{chair}_{w_0}(x)]$ $\qquad\qquad$ $\lambda x \,.\, \text{blue}_{w_0}(x)$

ι $\qquad$ $\lambda x \,.\, \text{chair}_{w_0}(x)$ $\qquad$ $\lambda w \,.\, \lambda x \,.\, \text{blue}_w(x)$ $\quad$ w_0

the $\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ blue

$\lambda w \,.\, \lambda x \,.\, \text{chair}_w(x)$ $\qquad$ w_0

chair
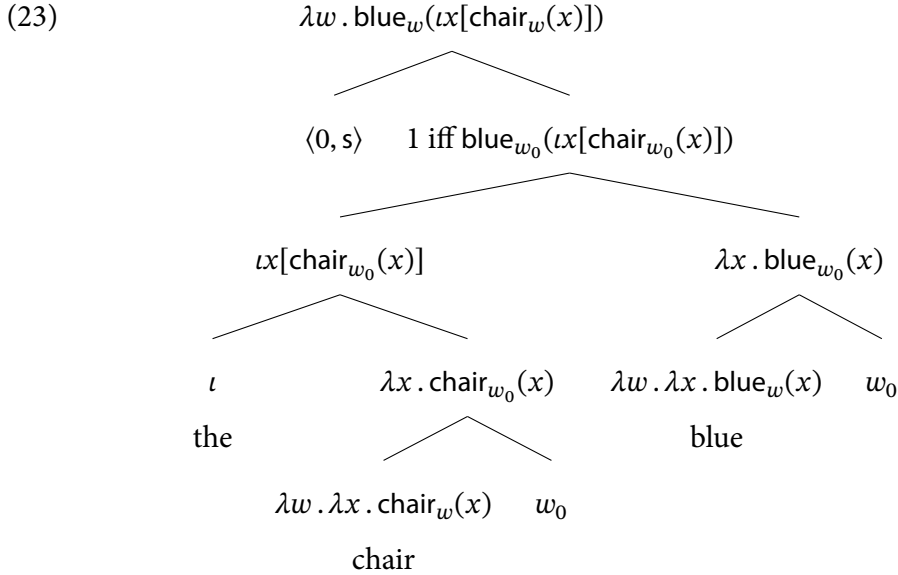
A nice feature of this approach is that it allows us to handle intensionality just with our existing semantic composition rules (i. e., there is no need for a distinct composition rule of *Intensional Functional Application*).

I adopt a Kripkean ontology, according to which individuals may exist across possible worlds (Kripke 1980). This is implicit in much work on natural language semantics, but see, e. g., Heller & Wolter 2011 and Uli Sauerland 2014 for applications of Lewis's (1986) counterpart ontology to natural language semantics in a compositional setting.

To see how we derive modal ascriptions consider the following toy Kratzerian denotation for a existential modal.

(24) $[\![\text{might}]\!] = \lambda p \,.\, \lambda q \,.\, \exists w[p(w) \wedge q(w)]$

---

8 In the metalanguage truth conditions, $P_w(x)$ is to be read as x is a P in w.

(25) $\lambda w . \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \, \text{American}_{w''}(\text{John}) \end{bmatrix}$

$\lambda w \quad 1 \text{ iff } \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \, \text{American}_{w''}(\text{John}) \end{bmatrix}$

DP $\quad \lambda x . \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \, \text{American}_{w''}(x) \end{bmatrix}$

John

$\lambda x \quad 1 \text{ iff } \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \, \text{American}_{w''}(x) \end{bmatrix}$

$\lambda q . \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \, q(w'') \end{bmatrix} \qquad \lambda w' . \text{American}_{w'}(x)$

$\lambda w' \quad 1 \text{ iff } \text{American}_{w'}(x)$

$\lambda p . \lambda q . \exists w'' \begin{bmatrix} p(w'') \\ \wedge \, q(w'') \end{bmatrix} \qquad R_w$

might $\qquad \qquad R_{\langle st,t \rangle} \quad w_s \qquad t_x \quad \lambda x . \text{American}_{w'}(x)$
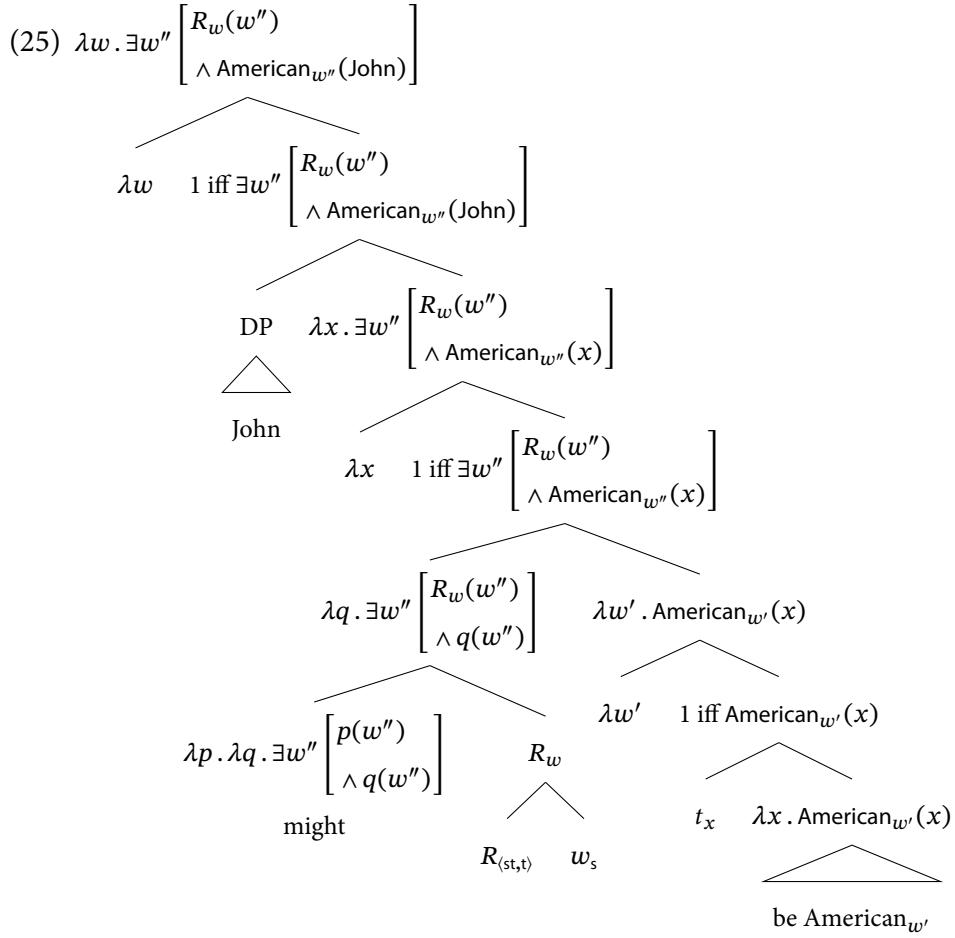
be American$_{w'}$

Let's assume that according to the local assignment g, $g(R) = \lambda w \,.$ what Patrick knows in w. *John might be American* will therefore be true relative to a world w and the assignment g iff it is compatible with what Patrick knows, that John is American. Transworld individuals are clearly crucial to this account of modal ascriptions, since John might be French in the actual world @ but American in w_0, where w_0 is in the set of worlds characterised by what Patrick knows. This will be sufficient to render the sentence true in @.

1.3 EVENTUALITIES

In this section, I introduce the notion of an *eventuality* (Davidson 1967, Bach 1986 which will play a prominent theoretical role in the remainder of this dissertation. I will develop a concrete syntax-semantics interface building on neo-Davidsonian event semantics and a constructivist syntax.[9]

In line with Davidson 1967 and much subsequent work, I assume the existence of *eventualities*[10] in the model.[11]. Much has been written on eventualities and their metaphysical properties in the philosophical literature, and I do not take a stance on this here beyond assuming that eventualities are *particulars*. There have been a number of proposals concerning how to cash this out in the Logical Forms[12] of sentences; overwhelmingly, subsequent authors have followed Davidson in treating sentence meanings as existential statements about eventualities. This captures basic entailment facts, such as the entailment from (26b) to (26a), on the assumption that manner adverbs such as *quickly* are intersective event modifiers.

(26)   a.   Josie buttered the toast.

$\exists e[e$ is a buttering of the toast by Josie$]$

   b.   Josie buttered the toast quickly.

$\exists e[e$ is a buttering of the toast by Josie $\wedge$ quick$(e)]$

---

9   Here I use the term constructivist in the sense of G. Ramchand (2013) to refer to the families of theories in which aspects of meaning traditionally housed in lexical entries in traditional lexicalist approaches to the grammar are decomposed and identified with functional structure in the syntax. In other words, I adopt the view that it is the *syntax* that is responsible for building structured meanings, not the lexicon. See, e. g., Borer 2005, G. C. Ramchand 2008, and Lohndal 2014 for representative work.

10   I use the term *eventualities* to subsume both *events* and *states*, following Bach 1986.

11   For the time being, I will not take a concrete stance on how to integrate *events* and *worlds*. I will come back to this question in §1.5

12   Here and where contextually appropriate I use the term *Logical Form* in the Russellian sense, i. e., the logical representation of a given sentence in the metalanguage. This is completely distinct from the linguistic notion of LF.

Where authors disagree in the event semantics literature is on the arity of predicates. There is a general consensus that at least eventive predicates take an event argument. The classical, Davidsonian view is a conservative existension of the standard treatment of a transitive verb such as *to butter* as a 2-place predicate. According to Davidson, the predicates denoted by eventive verbs take an additional event argument slot. This view is exemplified by the Logical Form in (27a).[13] Subsequently, starting from Castañeda's (1967) seminal paper, it has been suggested that predicates such as *to butter* are simply predicates over eventualities. Participants in eventualities, i. e. thematic arguments, are taken to be introduced via special expressions in the metalanguage which mediate the relation between an eventuality and its participants. This framework is commonly referred to as *neo-Davidsonian* event semantics, and is exemplified by the Logical Form in (27b). Finally, a more recent development is exemplified in the Logical Form in (27c). This lies somewhere between Davidsonian and neo-Davidsonian event semantics - the external argument is introduced by a special metalanguage expression, but the internal argument is taken to be a direct argument of the predicate denoted by the verb. I shall refer to this position as *Kratzerian* event semantics, building as it does upon Kratzer's (1996) influential work.

(27)   a. $\exists e[\text{buttering}(\text{Josie}, \text{theToast}, e)]$ *Davidsonian*

      b. $\exists e \begin{bmatrix} \mathcal{AG}(e) = \text{Josie} \\ \wedge\ \mathcal{TH}(e) = \text{theToast} \\ \wedge\ \text{buttering}(e) \end{bmatrix}$ *neo-Davidsonian*

      c. $\exists e \begin{bmatrix} \mathcal{AG}(e) = \text{Josie} \\ \wedge\ \text{buttering}(\text{theToast}, e) \end{bmatrix}$ *Kratzerian*

In this thesis I shall adopt the neo-Davidsonian conjecture. This is not merely an arbitrary technical choicepoint, but will be a crucial compo-

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13   Where harmless, and in lieu of giving a fully compositional semantics, I shall sometimes treat descriptions as denoting individual constants in the metalanguage.

nent of the account of clausal embedding argued for here. Neo-Davidsonianism is compatible with a number of conceivable implementations at the compositional level. For example, it is perfectly conceivable that a verb such as *to butter* has a denotation as in (28), and thereby maintain more orthodox assumptions about the nature of the syntactic representation feeding into the semantics.

(28) $\lambda e . \lambda x . \lambda y . \wedge \mathcal{AG}(e) = y$
$$\wedge \mathcal{TH}(e) = x$$
$$\text{buttering}(e)$$

I shall however adopt a more radical stance. Following Levinson 2010, I assume that *roots* uniformly denote predicates. The encyclopaedia includes the rule in (29) for interpreting $\sqrt{\text{butter}}$.

(29) $[\![\sqrt{\text{butter}}]\!] \leftrightarrow \lambda e . \text{buttering}(e)$

I assume that the special expressions in the metalanguage responsible for relating eventualities to their participants correspond to functional material in the syntactic representation, following, e. g., Lohndal 2014. I shall refer to these special expressions as *thematic functions*, and I shall basically take them to be functions from eventualities to their unique participant. For example, $\mathcal{AG}$ is a (partial) function from an eventuality to its unique agent. It is common in the neo-Davidsonian literature to instead understand these expressions as *relations* between eventualities and their participants. I adopt the functional stance since it directly captures *thematic uniqueness*, i. e. the requirement that each eventuality have a unique *agent*, *theme*, etc. See, e. g. Carlson 1984, Lohndal 2014, Champollion 2017 for discussion.

I will tentatively identify dub the functional head/feature bundle responsible for introducing internal arguments F_{int}. The encyclopaedia contains an instruction for interpreting F_{int} as in (30). F_{int} composes with an event predicate f, and an individual x, and returns a predicate over events e of which x is the unique theme, and f is true of e.

(30)　$\llbracket F_{int} \rrbracket \leftrightarrow \lambda f . \lambda x . \lambda e . \mathcal{TH}(e) = x \wedge f(e)$　$:: \langle et, \langle e, et \rangle \rangle$

The functional head/feature bundle responsible for introducing external arguments in F_{ext}, and the encyclopaedia contains an instruction for interpreting F_{ext} as in (31). F_{ext} composes with an event predicate f, an individual x, and returns a predicate over events e of which x is the unique agent, and f is true of e.

(31)　$\llbracket F_{ext} \rrbracket \leftrightarrow \lambda f . \lambda x . \lambda e . \mathcal{AG}(e) = x \wedge f(e)$

　　　　$:: \langle et, \langle e, et \rangle \rangle$

Putting all of the pieces together, I assume that the syntax generates the representation in (32) for the sentence *Josie is buttering the toast*.

(32) $\exists e \begin{bmatrix} \mathcal{AG}(e) = \text{Josie} \\ \wedge\ \mathcal{TH}(e) = \text{theToast} \\ \wedge\ \text{buttering}(e) \end{bmatrix}$

TP

DP ⋯

Josie

λx   T'

T $\exists e \begin{bmatrix} \mathcal{AG}(e) = x \\ \wedge\ \mathcal{TH}(e) = \text{theToast} \\ \wedge\ \text{buttering}(e) \end{bmatrix}$

$\mathcal{E}$ $\lambda e\,.\,\mathcal{AG}(e) = x$
$\wedge\ \mathcal{TH}(e) = \text{theToast}$
$\wedge\ \text{buttering}(e)$

t_x $\lambda x\,.\,\lambda e\,.\,\mathcal{AG}(e) = x$
$\wedge\ \mathcal{TH}(e) = \text{theToast}$
$\wedge\ \text{buttering}(e)$

$\lambda f\,.\,\lambda x\,.\,\lambda e\,.\,\mathcal{AG}(e) = x$ v
$\wedge\ f(e)$

F_{ext} v $\lambda e\,.\,\mathcal{TH}(e) = \text{theToast}$
$\wedge\ \text{buttering}(e)$

theToast $\lambda x\,.\,\lambda e\,.\,\mathcal{TH}(e) = x$

DP $\wedge\ \text{buttering}(e)$

the toast $\lambda f\,.\,\lambda x\,.\,\lambda e\,.\,\mathcal{TH}(e) = x$ $\lambda e\,.\,\text{buttering}(e)$
$\wedge\ f(e)$ $\sqrt{\text{buttering}}$

F_{int}
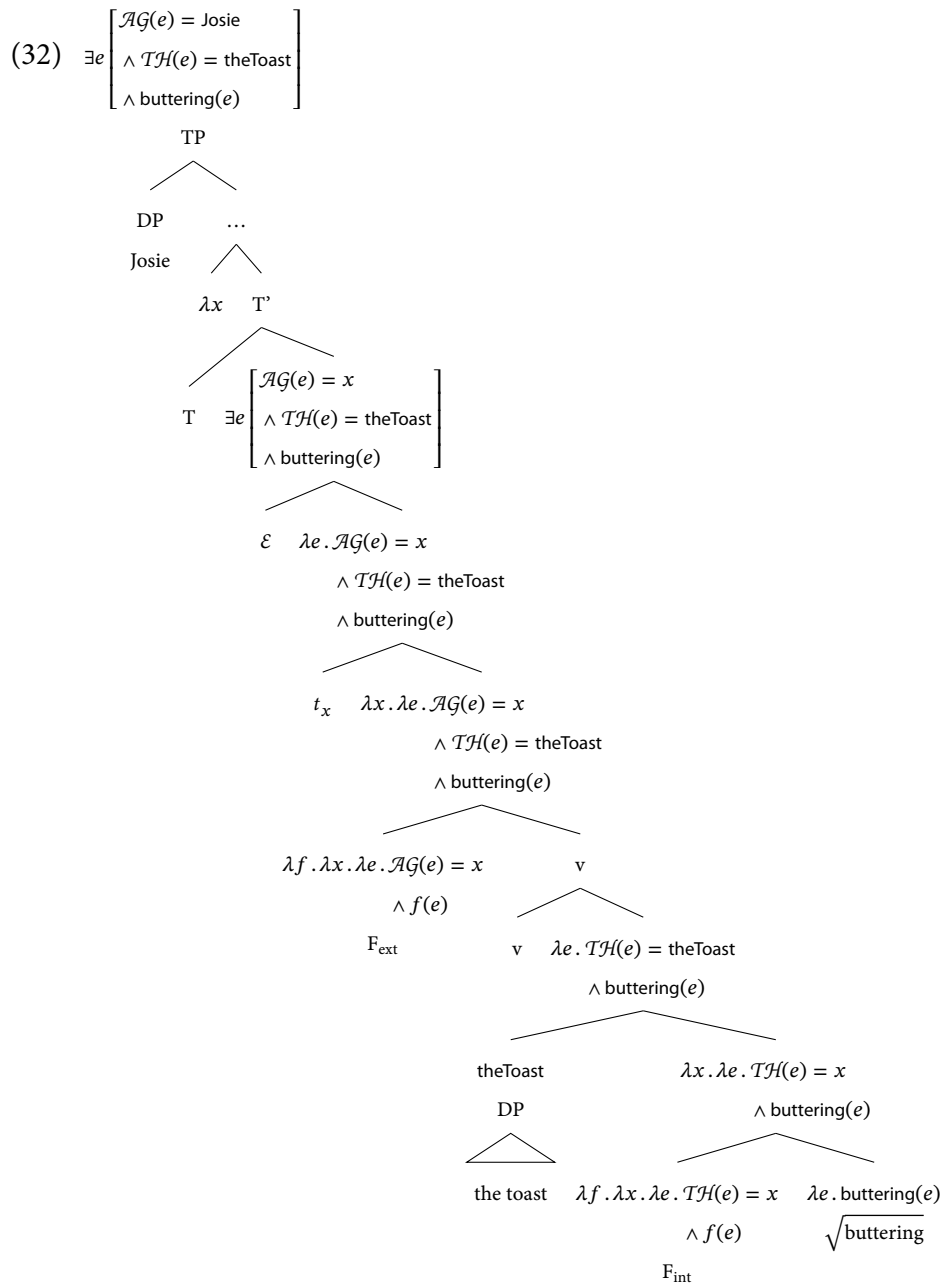
There are some non-trivial syntactic assumptions encoded here. Firstly, I assume that the internal argument *the toast* merges before the categorizer v. This is reminiscent of Harley's (2014) syntax, in that according to both Harley's account and the account outlined here, the internal argu-

43

ment is merged prior to the categorizer. Unlike Harley however, I do not assume that the root composes with its complement directly, but rather that introduction of the internal argument is mediated by the function head F_{int}. This is a necessary consequence of the conjecture that root meanings are simply modificational (Levinson 2010). I will not dwell on this point of disagreement here, but I will return to it in chapter 2. I assume that unlike the internal argument, the external argument is introduced above the categorizer v, mediated by a functional head F_{ext}.[14] In line with the vast majority of the literature on event semantics, I assume that the event argument of the verb is existentially closed by a covert operator $\mathcal{E}$.[15] The external argument undergoes A-movement to specTP in line with orthodox syntactic assumptions. Of course (32) is an extremely minimal syntactic representation, eliding material relating to, e. g., aspect, but the machinery assumed here is compatible with existing proposals concerning the semantics of tense and aspect, see e. g. Kratzer 1998, Hacquard 2006, and Beck & von Stechow 2015 for concrete im-

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14 I remain deliberately vague concerning additional properties of the argument introducing heads F_{int} and F_{ext}, and whether or not they should be identified with functional heads proposed in the existing literature on argument structure. For example, it would be natural to identify F_{ext} with Kratzer's (1996) *voice* head, and is far as I can see there is no real obstacle to doing so, but since nothing crucial hinges on this, I will refrain from making any concrete claims.

15 I will not say much about tense and aspect in this thesis, but it is possible to do without an ad hoc existential closure operator by holding an aspect head in the extended verbal projection responsible for closing off the event argument of the verb. Consider e. g. the semantics for aspect in (33) after Kratzer 1998, according to which aspect takes an event predicate f, and converts it to a predicate over *times*, existentially closing the event argument e.

(33) a. $[\![\text{PERF}]\!] = \lambda f . \lambda t . \exists e[\tau(e) \subseteq t \land P(e)]$

 b. $[\![\text{IMPERF}]\!] = \lambda f . \lambda t . \exists e[t \subseteq \tau(e) \land P(e)]$

Another possible compositional treatment of existential closure is offered by Champollion (2015), who argues that existential closure should be incorporated directly into the semantics of the root.
I won't explore these possibilities in depth here.

plementations, and Ramchand & Svenonius 2014 for coverage of similar ground.

1.3.1 *Stative predicates*

There is some controversy in the literature as to whether stative predicates, such as *believe* and *know* take a Davidsonian eventuality argument. Since many predicates which compose with clauses are stative, an important assumption underlying much of this thesis is that stative predicates such as *believe* and *know* are predicates over Davidsonian states (here I follow Parsons 1990, Landman 2000, Mittwoch 2005 and others). Some diagnostics for distinguishing stative vs. eventive predicates are given in (1.1). The contrast between stative *believe* and eventive *wonder* with respect to these diagnostics is given in (34-36).

	STATIVE	EVENTIVE
simple present	✓	✗
progressive	✗	✓
wh-cleft	✗	✓

Table 1.1: Diagnostics for *stative* vs. *eventive* predicates in English

(34) a. Henning believes that Naomi is here.

   b. ? Henning wonders if Naomi is here.

(35) a. * Henning is believing that Naomi is here.

   b. Henning is wondering if Naomi is here.

(36) a. * What Henning does is believe that Naomi is here.

   b. What Henning wonders is whether Naomi is here.

I assume that the encyclopaedia contains the correspondence rules in (37). A belief report will therefore end up denoting an existential statement about the existence of a *belief* state, whereas a sentence involving the verb *wonder* will end up denoting an existential statement about the existence of a *wondering* state. I take both stative and eventive roots to be of type $\langle e, t \rangle$, but they differ in the kinds of entities they range over. One way of encoding this in their denotations is to introduce primitive metalanguage predicates STATE and EVENT, which partition the domain of eventualities E. We can then partialize the functions denoted by different predicates these terms.[16]

(37) a. $[\![\sqrt{\text{belief}}]\!] \leftrightarrow \lambda s : \text{STATE}(e) . \text{belief}(s)$

  b. $[\![\sqrt{\text{wonder}}]\!] \leftrightarrow \lambda e : \text{EVENT}(e) . \text{wondering}(e)$

There has however been some controversy over adopting representations such as (37a) for stative predicates. I will briefly address arguments against a Davidsonian state argument in the remainder of this section, before moving on. Katz, in a number of papers (Katz 2000, Katz 2003, Katz 2008, see also Maienborn 2005a and Maienborn 2005b), argues against neo-Davidsonian state variables on the basis of the *stative adverb gap*, illustrated by the set of examples in (38).

(38) a. *John resembled Sue slowly.

  b. *She desired a raise enthusiastically.

  c. *They hate us revoltingly.   (Katz 2008: 221)

For Katz, the explanation for this state of affairs is that stative verbs such as *resemble Sue* lack a Davidsonian eventuality argument, and manner modifiers such as *slowly* are eventually modifiers. A manner modifier, therefore, may not compose with a stative predicate, since there is

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16 In subsequent formulae, I will often omit explicit partialisation of stative vs. eventive predicates, rather, the variable name *e* is taken to imply that the function is only defined for entities that are events, and the variable name *s* is taken to imply that the function is only defined for states.

no eventuality argument to modify. For Katz then, the Logical Form of *she desired a raise* is as in (40a), whereas the Logical Form assumed here, and by proponents of a Davidsonian account of stative predicates, in as in (40b).[17]

(40)   Sue desired a raise.

    a.   1 iff desire(Sue, aRaise)

    b. $\exists S \begin{bmatrix} \mathcal{EXP}(s) = \text{Sue} \\ \wedge\, \mathcal{CONT}(s) = \text{that Sue has a raise} \\ \wedge\, \text{desiring}(s) \end{bmatrix}$

As noted by, e. g., Mittwoch (2005) however, many of the examples presented in support of the stative adverb gap can be explained away on the basis of semantic clashes resulting from conceptual knowledge. For example, in (38a), a *resemblance* state is modifier by the manner adverb *slowly*. As Ernst (2016) points out, resemblance states are assumed to be static and do not normally change over time. The manner adverb *slowly*

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17 Note that the Logical Form in (40b) is neo-Davidsonian, in-line with the assumptions made throughout this thesis, but positing a Davidsonian eventuality variable for stative predicates is perfectly consistent with both Davidsonian and Kratzerian Logical Forms. Another interesting feature of the Logical Form in (40b) is that *desire* is an Intensional Transitive Verb (ITV). The salient reading here is what Quine (1960) refers to as the *notional* reading, i. e. it does not entail that there exists an x such that x is a raise and Sue desires x. I capture the notional reading here by assuming that the argument *a raise* bears some relation to the *content* of the desiring state (see Forbes 2006 for related ideas). I elaborate on these notions in subsequence chapters.

I will however note that there are some unsatisfactory features of the analysis in (40b). For example, the content of Sue's desiring state seems to be a *de se* proposition. To illustrate, consider the example in (39).

(39)   Sue desired a haircut.

Imagine now a scenario in which Sue sees a reflection of herself in mirror, but mistakenly believes it to be someone else. Sue desires that the person in the mirror has a haircut. (39) is intuitively judged to be false in this scenario, suggesting that the Logical Form posited in (40b) cannot be quite right. I leave to future work the question of how to integrate existing theories of *de se* attitudes (see, e. g., Stephenson 2007 and Pearson 2013) into the framework argued for in this work.

however necessarily described a rate of change over time, and therefore presupposes that the eventuality it modifies is dynamic.

Ernst (2016) shows more generally that manner modification of stative predicates is very much possible and much more common than is generally assumed. I give some examples here from Ernst 2016: 266, which crucially include examples of stative attitude verbs such as *know* undergoing manner modification. Ernst, after a notably thorough empirical study concludes that: '[…]the possibility of manner modification of stative predicates is a matter of semantic (in)compatibilities. In general, stative predicates are semantically impoverished, lacking the range of temporal, agentive, and aspectual properties that normally are a part of dynamic events, and so there are simply fewer properties that allow modification.' (Ernst 2016: 270).

(41)   a.   'He knew dirt, though knew it exactly, bodily.'

(Ursula LeGuin, *Birthday of the world*, p. 261)

  b.   'I wanted [the dog] ferociously, indignantly, unbendingly – blue dapple, kinked tail, and all.'

(Mary Doria Russell, *Dreamers of the day*, p. 23)

  c.   'She's mastered semantics, but understands syntactic theory rather unevenly.'

1.4   ARGUMENTS FOR NEO-DAVIDSONIANISM

1.4.1   *Cumulative readings with distribute quantifiers*

Kratzer (2003) points out, following Schein (1993), that (42) has a *cumulative* interpretation. That is to say, it is true just in case the following holds: for each x, s.t. x is one of the three copy editors, there is a mistake y in the manuscript, s.t., x caught y, *and* for every mistake y in the manuscript, one of the three copy editors x is s.t., x caught y. Intuitively,

each of the three copy-editors did some of the catching, and every one of the mistakes got caught.

(42)   Three copy editors caught every mistake in the manuscript.

(Kratzer 2003: ch. 2, ex. 1)

Kratzer (2006) and Schein (1993) argue at some length that it is necessary to sever the internal argument in the logical representation of (42) to provide adequate truth conditions. See also Lohndal 2014 for an overview.

1.4.2   *Out-prefixation*

Ahn 2015, 2016 presents a novel argument for severing the internal argument based on *out*-prefixation in English, which is illustrated by the example in (43a). Ahn (2016) observes that *out*-prefixation displays an intriguing cluster of properties. To begin with, it is highly productive. When the prefix *out-* composes with a predicate *P* to form a complex predicate *out-P*, the internal argument of *out-P* is assigned the same thematic role as the external argument of *P* (the external argument remains unchanged). Observe in (43b), the internal argument ie interpreted as a *theme*, and the external argument is interpreted as an an *agent*. In (43a) however, the internal argument of *out-P* is assigned the same thematic role as the external argument of *P* – *agent*.

(43)   a.   Mike clearly has outcooked everyone.

b.   Mike clearly has cooked tempeh.

Ahn observes that *out*-prefixation feeds the availability of passivization, even if the predicate to which *out-* is prefixed does not generally allow passivization. This is illustrated by the paradigm in (44) (Ahn 2016: 4).

(44) a.   By mid-September, they numbered 10,000.

b. *By mid-September, 10,000 were numbered (by them).

c.   By mid-September, they out-numbered us.

d.   By mid-September, we were out-numbered (by them).

Ahn concludes, based on the data from passivisation and other facts, that the prefix *out-* projects independent functional structure. Crucially, Ahn observes that *out-* prefixation *always* obligatorily suppresses the internal arguments of the host predicate *P*, irrespective of *P*'s valency. This is illustrated in (45) for *donate* (Ahn 2016: 5).

(45) a.   Jackie donated money to museums.

b.   Jackie outdonated (*money) (*to museums) Lisa (*money) (*to museums).

As Ahn, observes all evidence points towards the conclusion that the internal argument of *P* is absent from the derivation entirely, when *out-* prefixation takes place. Ahn concludes that prefixation with *out-* suppresses whatever is responsible for introducing the internal argument of *P*. Since *out-* does not suppress *P* itself, *P* cannot be what is responsible for introducing the internal argument. The argument relies on the widely-assumed *Monotonicity Hypothesis* (Koontz-Garboden 2007), which says that merger of a formative cannot destroy syntactic structure. Ahn's explanation is that internal arguments are *severed*, i.e., introduced by a functional head (F_{int}). *out-* directly selects for $\sqrt{P}$, thereby blocking merger of F_{int}. Importantly, this analysis of *out-*prefixation depends on the internal argument being severed. The syntactic representation Ahn suggests for *out-*prefixation is given in (46b).

(46) a. Ray outcooked them.

b.

```
                        F_ext P
                       /      \
                    DP         F_ext '
                    /\         /    \
                  Ray      F_ext    F_int P
                                    /      \
                                  DP        F_int '
                                  /\        /     \
                               them    F_int    out-P
                                                /    \
                                             out-    √P
                                                     |
                                                   √cook
```
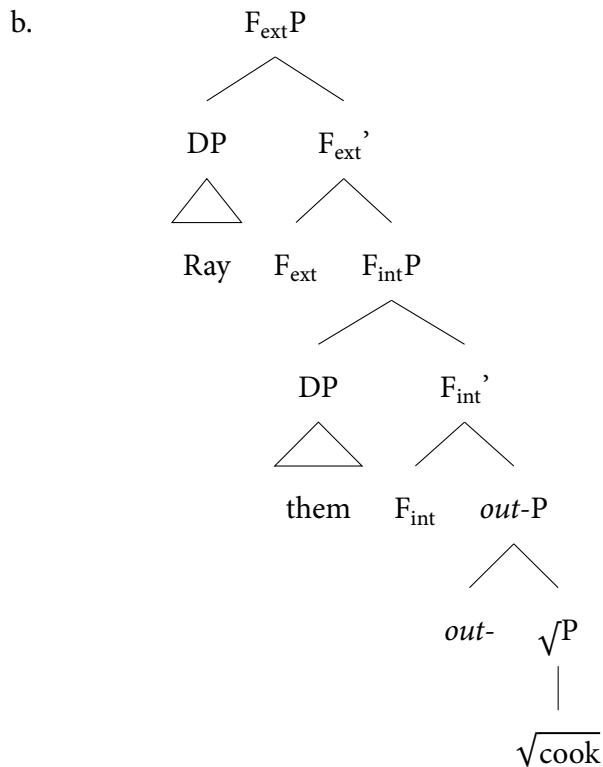
Ahn does not give a fully-fledged compositional semantics for *out*-prefixation, and this constitutes an interesting topic for future research.

1.5 EVENTS AND WORLDS

There is an unfortunate lack of work (at least, in the domain of *linguistic* semantics) outlining a specific conception of how eventualities and possible worlds, both widely assumed to be part of our linguistic ontology, are integrated in the semantics. Since I follow Kripke in assuming that individuals may exist across possible worlds, and I follow Davidson in taking eventualities to be, essentially, individuals (contra Kim 1973), it seems most straightforward to assume that eventualities, like other individuals, may exist across possible worlds.

I depart here from, e. g., Beck & von Stechow 2015, who assume a mereological parthood relation between events and worlds, and that an event exists in maximally one world. I take it that there are a number of conceivable semantics systems, depending on one's ontology concerning individuals and eventualities. Beck & von Stechow adopt a *hybrid* system – that is to say, they adopt a Kripkean ontology for individuals, but in dealing with modal attributions concerning eventualities, they are wedded to a counterpart ontology (although they do not make this explicit). Another conceivable possibility is that one is wedded to a counterpart ontology for individuals, but a Kripkean ontology for eventualities (this seems to be the position represented by Lewis 1986). Alternatively, one could adopt a unified system which makes use of the same semantic machinery for dealing with modal attributions concerning inidviduals and eventualities - either one could adopt a Kripkean ontology for both, or a counterpart ontology for both.

A clear conceptual argument in favour of ascribing to eventualities the same metaphysical properties as individuals is that eventuality-denoting descriptions behave identically to individual-denoting descriptions in modal ascriptions. In the following example, the eventuality-denoting description *the destruction of Rome* is interpreted *de dicto* with respect to the existential model *might*. This can easily be accommodated within an orthodox theory of modality if there are transworld events which may vary in their properties.

(47)   The destruction of Rome might have been gradual.

(48)
$$\lambda w \,.\, \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge\ \mathsf{gradual}_{w''}(\iota e \begin{bmatrix} \mathsf{destroying}_w(e) \\ \wedge\ \mathcal{TH}_w(e) = \mathsf{Rome} \end{bmatrix}) \end{bmatrix}$$

λw ...

$\iota e \begin{bmatrix} \mathsf{destroying}_w(e) \\ \wedge\ \mathsf{theme}_w(e) = \mathsf{Rome} \end{bmatrix}$ $\lambda x \,.\, \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge\ \mathsf{gradual}_{w''}(e) \end{bmatrix}$

DP

the destruction$_w$
of Rome

λe ...

might_{R_w} ...

$\lambda w'$ ...

t_e have
been gradual$_{w'}$
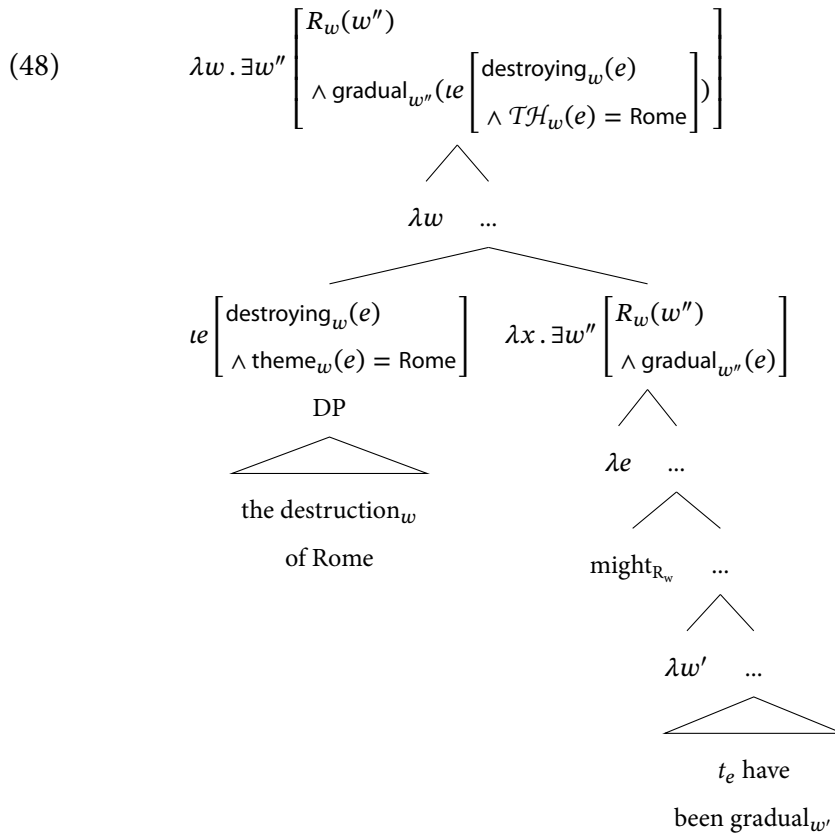
The following example shows that the function introducing an eventualities argument can be interpreted *de dicto* with respect to the existential modal *could*. Examples such as this can also be considered an argument in severing the internal argument from the verb, as it is difficult to see how such as interpretation could be derived if *sack* were to take *Rome* as its argument directly.

(49)   The sacking of Rome could have been of Carthage.

(50)

$$\lambda w \, . \, \exists w'' \begin{bmatrix} R_w(w'') \\ \\ \wedge \; \mathcal{TH}_{w''}(\iota e \begin{bmatrix} \text{sacking}_w(e) \\ \wedge \; \mathcal{TH}_w(e) \\ = \text{Rome} \end{bmatrix}) = \text{Carthage} \end{bmatrix}$$

$\lambda w \quad \ldots$

$$\iota e \begin{bmatrix} \text{sacking}_w(e) \\ \wedge \; \mathcal{TH}_w(e) \\ = \text{Rome} \end{bmatrix} \qquad \lambda e \, . \, \exists w'' \begin{bmatrix} R_w(w'') \\ \wedge \; \mathcal{TH}_{w''}(e) \\ = \text{Carthage} \end{bmatrix}$$

DP

the sacking

of Rome

$\lambda e \quad \ldots$

$\text{could}_{R_w} \quad \ldots$

$\lambda w' \quad \ldots$

$t_e \quad \lambda e \, . \, \mathcal{TH}_{w'}(e)$

$= \text{Carthage}$

have been

$\text{of}_{w'}$ Carthage
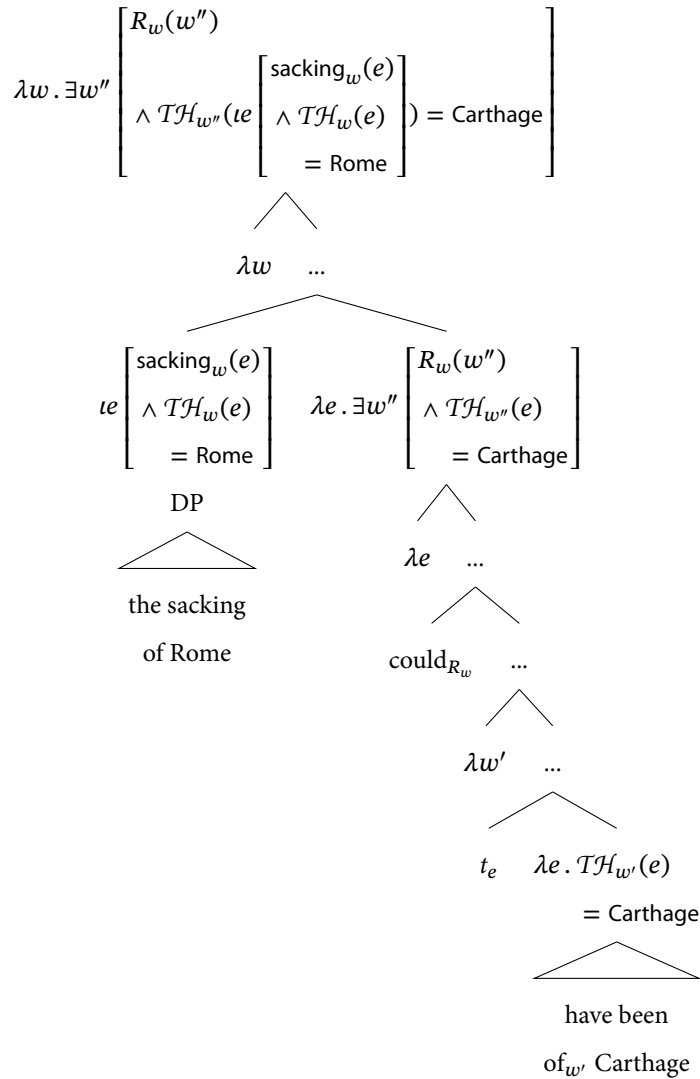
Finally, I show that the temporal properties of events may vary across worlds. Note that I assume a temporal trace function τ that maps an event e and a world of evaluation w to e's run-time in w. In the following example, the aktionsart modifier *in two hours* is interpreted *de dicto* with respect to the existential modal *could*. The neo-Davidsonian syntax-semantics interface developed here makes it easy to capture this range of *de dicto* interpretations associated with eventuality-denoting nominals.

(51) $[\![$for two hours$]\!] = \lambda e \,.\, \mathsf{hours}(\tau_w(e)) = 2$

(52)   The examination of the students for two hours
could have been for three hours.

(53)

(54) $[\![①]\!]$
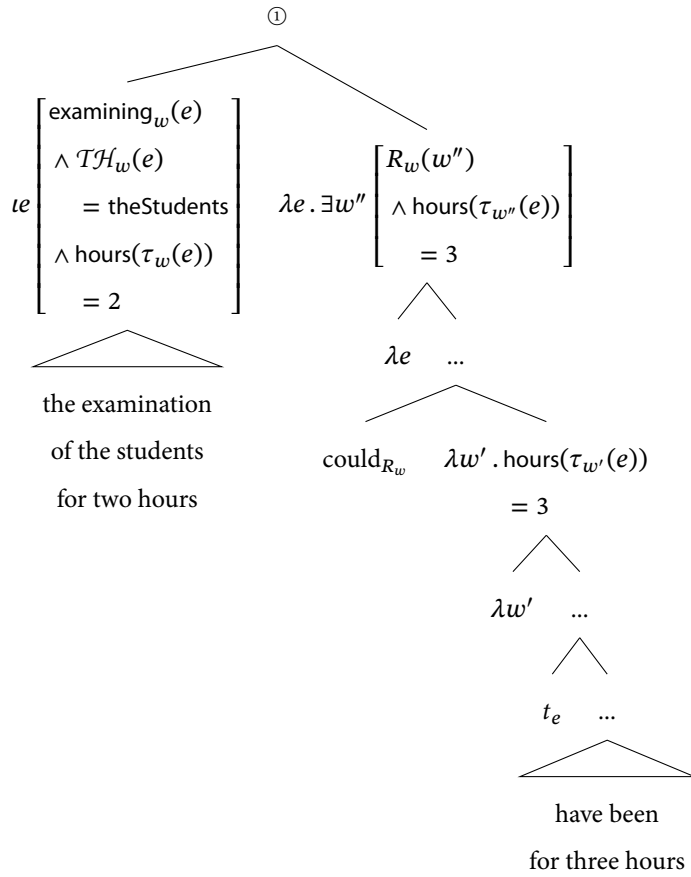
$$= 1 \text{ iff } \exists w'' \begin{bmatrix} R_w(w'') \\ \\ \wedge\, \mathsf{hours}\left(\tau_{w''}\left(\iota e \begin{bmatrix} \mathsf{examining}_w(e) \\ \wedge\, \mathcal{TH}_w(e) = \mathsf{theStudents} \\ \wedge\, \mathsf{hours}(\tau_w(e)) = 2 \end{bmatrix}\right)\right) = 3 \end{bmatrix}$$

THAT-CLAUSES AS MODIFIERS

THIS CHAPTER argues that *that*-clauses and DPs compose with embedding verbs in fundamentally different ways, and develops an analysis in which this falls out from the compositional semantics. In §2.1, I introduce Pietroski's (2000, 2002) observations concerning the verb *explain*, and tie this to the broader problem of *substitution failures*, addressed primarily in philosophy of language literature. In §2.2, I introduce acfpPropDP, and argue contra King (2002) and others, that PropDPs are syntactically nominal. On the basis of PropDPs, I show that the substitution failures do not arise because the the interpretation of the verbal root is mediated by the syntactic category of its complement. In §2.3 I introduce that idea that *that*-clauses denote predicates over contentful entities, concentrating on the composition of *that*-clauses with content nouns. In §2.4 I show how *that*-clauses can be treated as modifiers in the verbal domain. In §2.5 I argue that nominalisations of clause-taking roots provides additional evidence for the approach to clausal embedding outlined in this thesis. In §2.6, I show how to account for substitution failures beyond *explain*, and sketch how to account for the Kratzer/Marantz generalization within the system developed here, in which all arguments are severed.

"The word adjective (epitheton in Greek) is itself an adjective meaning 'placed on top', 'added', 'appended', 'foreign'. Adjectives seem fairly innocent additions, but look again. These small imported mechanisms are in charge of attaching everything in the world to its place in particularity. They are the latches of being."

— The Autobiography of Red, Anne Carson

2.1 *EXPLAIN* AND INTER-SUBSTITUTABILITY

2.1.1 *The basic observation*

Pietroski (2000, 2002) noticed that, when *P* is a true proposition, *the fact that P* and *that P* are not inter-substitutable when embedded under the verb *explain*.

(55) a. Angela explained [DP the fact that Boris resigned].

explanandum

   b. Angela explained [CP that Boris resigned].

explanans

First, we can show that (55a) and (55b) are truth-conditionally independent; (55a) does not entail (55b), and vice versa.

Imagine a context in which everyone is wondering why Boris resigned, and Angela announces that Boris has long-term health issues. Since everyone knows that Boris has in fact resigned, Angela does not bother to mention this. In this scenario, (55a) is *true* but (55b) is *false*.

Now, imagine a context in which, one day Boris does not come in to work, and everyone is wondering why. Angela announces that Boris resigned (which is true), but does not say why. In this context, (55b) is *true* but (55a) is *false*.

Intuitively, the embedded DP in (55a) is interpreted as the thing that an Anita gave an explanation for, whereas in (55b) the embedded CP is interpreted as being Anita's explanation. Following Pietroski, we informally refer to the role that the embedded DP plays in (55a) as the *explanans*, and the role that the embedded CP plays in (55b) as the *explanandum*.

Pietroski points out that the failure of inter-substitutability is puzzling, given the following assumption:

(56)   'The referent of 'that Q' is the proposition expressed by 'Q'; and facts
        are true propositions; so if 'Q' is true, then the referent of 'that Q' is the
        fact that Q.'   (Pietroski 2000: 655)

Pietroski's (2000, 2002) goal is to provide an account of the meaning
different between (55a) and (55b) while maintaining the assumption in
(56).

2.1.2   *Pietroski's account*

Pietroski's account of this is that *explain* may assign different θ-roles, de-
pending on the nature of its complement. Concretely, *explain* assigns
the constituent [$_{DP}$ the fact that Boris resigned] the theme θ-role ($\mathcal{TH}$),
and the constituent [$_{CP}$ that Boris resigned] the content θ-role ($\mathcal{CONT}$).
Pietroski cashes this idea out in a neo-Davidsonian event semantics (see,
e.g., Parsons 1990), assigning (55a) the Logical Form in (57b), (55b) the
Logical Form in
    (58b).[1] I shall retain, from Pietroski, the insight that neo-Davidsonianism
provides us with the expressive power we need to distinguish the two
readings at Logical Form.

(57)   a.   Angela explained the fact that Boris resigned.

        b. $\exists e \begin{bmatrix} \text{explaining}(e) \\ \wedge\ \mathcal{AG}(e) = \text{Angela} \\ \wedge\ \mathcal{TH}(e) = \text{the fact that Boris resigned} \end{bmatrix}$ *Explanandum*

---

1 I depart slighty from the Logical Forms that Pietroski actually proposes, in that he
treats thematic roles as *relations* between events and individuals in the metalanguage,
whereas here they are *functions* from events to individuals. For the purposes of Piet-
roski's arguments, nothing crucial rests on this distinction, and therefore I maintain
the assumption that thematic roles are functions in order to maintain commensurabil-
ity.

(58) a. Angela explained that Boris resigned.

b. $\exists e \begin{bmatrix} \text{explaining}(e) \\ \land \mathcal{AG}(e) = \text{Angela} \\ \land \mathcal{CONT}(e) = \text{that Boris resigned} \end{bmatrix}$ *Explanans*

Note that Pietroski does not elaborate on *why* exactly *explain* always seems to assign the $\mathcal{CONT}$ θ-role to a *that*-clause and the $\mathcal{TH}$ θ-role to a nominal argument headed by a content noun such as *fact*. Perhaps the *explanans*/*explanandum* meaning alternation arises to an idiosyncratic property of $\sqrt{\text{explain}}$.[2]

2.1.3 *Substitution failures*

The meaning alternation that Pietroski observes with *explain* is, I conjecture, a subcase of a much broader class of what philosophers of language have dubbed *substitution failures* (see, e. g., Prior 1971, King 2002, Pryor 2007, Forbes 2014). King (2002: 344) gives the following examples of substitution failures involving the clausal embedding verbs *remember*, *hear*, and *fear* respectively.

(60) a. Amy remembers the proposition that first-order logic is undecidable.

b. Amy remembers that first-order logic is undecidable.

---

2 Note at this point that the *explanans*/*explanandum* meaning alternation persists when $\sqrt{\text{explain}}$ is nominalised.

(59) a. Angela's explanation of the fact that Boris resigned was unconvincing.

                                                    explanandum

b. Angela's explanation that Boris resigned was unconvincing.

                                                 explanans

Observe that in (59a), what is predicated of *unconvincing* is the explanandum that Angela proffers for Boris' resignation. In (59b), what is predicated of *unconvincing* is the proposition *that Boris resigned* – an explanans proffered by Angela for some implicit explanandum.

(61) a.   Jody heard that first-order logic is undecidable.

      b.   Jody heard the proposition that first-order logic is undecidable.

(62) a.   Jody fears that first-order logic is undecidable.

      b.   Jody fears the proposition that first-order logic is understandable.

As observed by King, the minimal pairs in (60-62) are all truthcon-ditionally distinct. Consider (60b): clausal-embedding *remember* is typically assumed to be factive.[3] In a context where, e. g., Amy has taken a logic class, and remembers the decidability of FoL being discussed, but (falsely) believes that FoL is decidable, (60b) seems false. (60a), on the other hand, seems true in this context – Amy's beliefs concerning the whether or not FoL is decidable do not in fact seem to bear on the truth of (60a). Both (61b) and (62b) can be understood, but are typically judged as infelicitous; (61b) attributes to an abstract object (a proposition) the capacity to be audible, whereas (62b) attributes to Jody fear of an abstract object. Both scenarios require some mental gymnastics to render plausible. (61a) and (62a) are of course both acceptable and felicitous; (61a) says something about the content of what Jody has heard, and (62a) says something about the content of Jody's fears.

Generally speaking, it seems that *that*-clauses specify the *content* of the eventuality introduced by the embedding verb, although there are a small class of exceptions, such as *prove* (Safir 1982), which we'll return to later. DPs, on the other hand, including a DP headed by a content noun, or a Content DP (CONTDP), often but not always stand in a more idiosyncratic relation to the embedding verb.

2.2   SYNTACTIC CATEGORY

In this section, I argue, contra, e. g., King (2002),[4] that it is not the syntactic category of the complement that is responsible for substitution

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3 A *factive* predicate presupposes the truth of its complement.

4 See also Pryor (2007) for some independent arguments against King's (2002) analysis.

failures, but rather its semantic type. The logic of the argument is as follows: there exists a class of expressions which I dub Propositional DPs (PROPDPs), which are syntactically nominal, but which nevertheless are compatible with both the *explanans* and the *explanandum* interpretations with *explain*. A non-exhaustive list of the expressions I classify as PROPDPs is as follows:

(63) PROPDPs

    a.   DPs headed by the noun *thing*, e.g., *the same thing, a different thing, most things, two things, something, everything,* etc.

    b.   The simplex *wh*-expression *what*.

    c.   Anaphoric expressions such as *it* and *that*.   (Asher 1993)

    d.   Null operators in comparatives.

                                        (Kennedy & Merchant 2000)

The criterion for inclusion in the class of PROPDPs, specifically as opposed to CONTDPs such as *the fact*, is distributional. Embedding verbs in English can be usefully divided into three categories depending on their selectional properties. *Believe*-type verbs may embed both CPs and DPs – both CONTDPs and PROPDPs in the latter case, as illustrated in (64). *Complain*-type verbs may embed CPs, but not DPs (neither CONTDPs nor PROPDPs), as illustrated in (66). Most importantly for our purposes here, *think*-type verbs may embed both CPs, but only a sub-class of DPs – those which I have called PROPDPs here.[5] The selectional properties of these three classes of embedding verbs are illustrated below.

(64) *believe*-type verbs

    a.   Abed believes [$_{CP}$ that Shirley is upset].

    b.   Abed believes [$_{DP}$ the rumour that Shirley is upset].

---

5 Note at this point that The fact that *think*-type predicates may embed propDPs undermines any purely syntactic explanation for their selectional properties, e. g., an account in terms of c-selection (Grimshaw 1979).

    c.   Abed believes [$_{DP}$ everything that Troy believes].

(65)   *complain*-type verbs

    a.   Abed complained [$_{CP}$ that Shirley is upset].

    b.   *Abed complained [$_{DP}$ the rumour that Shirley is upset].

    c.   *Abed complained [$_{DP}$ everything that Troy complained].

(66)   *think*-type verbs

    a.   Abed thinks [$_{CP}$ that Shirley is upset].

    b.   *Abed thinks [$_{DP}$ the rumour that Shirley is upset].

    c.   Abed thinks [$_{DP}$ everything that Troy thinks].

On the basis of similar facts, King (2002) and Forbes (2014) suggest that PropDPs are *syntactically* distinct from other DPs. In the following, I give two independent arguments that PropDPs are indeed nominal.[6]

2.2.1 *PropDPs are syntactically nominal*

The first piece of evidence that PropDPs really are syntactically nominal is that they are sensitive to abstract case in a way which *that*-clauses aren't. Consider, e. g., the paradigm in (67). As is well known, when a verb is passivised, it loses its ability to assign structural accusative case.[7] The fact that an embedded clause may survive under passivisation, as in (67a) is generally taken to indicate that *that*-clauses don't require case (Stowell 1981). PropDPs pattern with ContDPs, and may not survive under passivization, indicating that they both require case. This is illustrated in (67c) and (67b) respectively.

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6 Nathan (2006) also notes that what I call PropDPs behave syntactically like other nominals. Nathan however is concerned with PropDPs embedded under question-embedding verbs such as *wonder*. I return to this issue in ch. 3.

7 The correlation between lacking an *agent* argument and being unable to assign structural accusative case is known as *Burzio's generalization*

(67)   Passivisation

    a.   It is widely believed [CP that Shirley is upset].

    b.   *It is widely believed [DP the rumour that Shirley is upset].

    c.   *It is widely believed [DP everything that Troy believes].

Along similar lines, it is well known that raising verbs such as *seem* and *appear* do not assign structural accusative case. A *that*-clause may nonetheless surface with a raising verb, as in (68a), which is as expected on the assumption that *that*-clauses don't require case. CONTDPs and PROPDPs pattern together in being disallowed in this environment, as illustrated in (68b) and (68c) respectively.

(68)   Raising

    a.   It seems [CP that Shirley is upset].

    b.   *It seems [DP the rumour that Shirley is upset].

    c.   *It seems [DP everything that Troy believes].

The second piece of evidence that PROPDPs are syntactically nominal comes from the *[P CP] constraint – the generalization that *that*-clauses in English may not surface as the complement of a preposition, illustrated in (70a).[8] PROPDPs may surface as the complement of a preposition, as in (70c), much like CONTDPs (70b).

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8 The explanation for the *[P CP] constraint is not generally agreed upon. Probably the most widely accepted explanation is Stowell's (1981) *Case Resistance Principle*, which appeals to the idea that *that*-clauses do not only not need case, but they actively resist any environment in which case is typically assigned. In order to escape a case-marking environment, *that*-clauses typically right-extrapose, but given the independent ban on P-stranding rightward movement (illustrated in (69)), this is not a viable strategy when the *that*-clause is a prepositional complement.

(69)   a.   Fry thought [PP about going to see a movie] yesterday.

    b.   Fry thought *t* yesterday [PP about going to see a movie].

    c.   *Fry thought [PP about *t*] yesterday going to see a movie.

There are some major issues with the *Case Resistance Explanation* as a more general explanation. There many languages, such as Danish (see, e. g., Hankamer & Mikkelsen

(70)   The *[P CP] constraint

    a.   * Annie heard about [_CP_ that Jeff is getting married].

    b.   Annie heard about
       [_DP_ the rumour that Jeff is getting married].

    c.   Annie heard about [_DP_ something]
       – namely, that Jeff is getting married.

2.2.2   PROPDPs and explain

Having established that PROPDPs are syntactically nominal, we can use them as a diagnostic for the source of the meaning alternations with *explain* and other verbs (i. e., substitution failures). If these meaning alternations are conditioned by the *syntactic category* of the embedded constituent, we predict that when a PROPDP is embedded under *explain*, the only available reading should be the *explanandum* reading, since PROPDPs are syntactically nominal.

The example in (71a) shows that (unsurprisingly), a PROPDP may be an *explanandum* (i. e., a $\mathcal{TH}$). Here, *something* is interpreted as the whatever Angela proferred an explanation *for*. More interestingly, the example in (71b) shows that a PROPDP may be an *explanans* (i. e., a $\mathcal{CONT}$). Here, *two things* must be interpreted as an *explanans*, since otherwise the sentence would be false in this context, since there is only a single *explanandum* (the fact that Boris resigned).

(71)   a.   Angela explained the fact that Boris resigned,
        therefore Angela explained something.

    b.   Angela gave two explanations for the fact that Boris resigned,
        therefore Angela explained two things.

2012) in which *that*-clauses can be the complements of prepositions, but nonetheless show a similar signature to *that*-clauses in English with respect to their case properties. See also D. Pesetsky 2014 for criticism of Stowell's (1981) account, and a sketch of an alternative explanation.

Importantly, this observation generalizes to the broader class of embedding verbs. This is clearest in the case of (72c). When *hear* takes a nominal complement, even a CONTDP, it generally entails some auditory stimulus. This is why (73) is infelicitous, since *facts* are abstract objects and cannot be heard. When *hear* composes with a *that*-clause on the other hand, it does not entail any ordinary stimulus, but simply means that the attitude holder was *made aware* that *p*. The felicity of (72c) shows that *hear* may retain this sense when it composes with a PROPDP.

(72)   a.   Jeff fears that Mary will get angry and that she will leave, therefore Jeff fears two things.

       b.   Jeff is imagining that Shirley is upset, therefore Jeff is imagining something.

       c.   Jeff heard that Shirley is upset, therefore Jeff heard something.

(73)   # Jeff heard the fact that Shirley is upset.

2.3   *THAT*-CLAUSES IN THE NOMINAL DOMAIN

2.3.1   *A note on the notion of content*

Following Kratzer 2006, Moulton 2009, 2015, Uegaki 2015a and others, I assume the existence of a metalanguage function *CONT* that maps an entity *x* and a world *w* to the propositional content of *x* in *w*. What kind of things have content? I assume that certain entities are inherently contentful, such as *facts, stories, theories*, etc. On an intuitive level however, is seems that not all entities which we might prima facie expect to be contentful may compose with a *that*-clause. Consider, e. g., the contrast between *story* in (74a), and *book* in (74b).

(74) a.   We've all heard the story
           [$_{CP}$ that Donald started with nothing].

    b.   *We've all read the book
           [$_{CP}$ that Donald started with nothing].

The natural conclusion to draw from such contrasts is that the linguistic notion of a *contentful entity* is distinct from the intuitive notion. *CONT* is defined for world, individual pairs $\langle w, x \rangle$ if $\text{story}(w)(x) = 1$, but not if $\text{book}(w)(x) = 1$. There seem to be certain generalizations governing which classes of nominals may compose with *that*-clauses and therefore should be considered to range over contentful entities. Quite generally, *media artifact nouns*, such as *book*, *film*, and *newspaper* do not display this behaviour.[9]

2.3.2 *That-clauses as predicates of contentful entities*

Moulton (2009, 2015), building on work by Kratzer (2006), proposes that *that*-clauses denote (the characteristic function of) a set of individuals with propositional content, as in (75-②). Contrast this with the standard assumption that a *that*-clause denotes a proposition (type $\langle s, t \rangle$), in (75-①). The comparison is given in (75).

(75) $[\![[_{CP} \text{ that Shirley left }]]\!] = \begin{cases} ① \, \lambda w' \, . \, \text{S left in } w' \\ \\ ② \, \lambda x \, . \, CONT_w(x) \\ \qquad = \lambda w' \, . \, \text{S left in } w' \end{cases}$

Let us unpack the Kratzer/Moulton *that*-clause denotation. *CONT* is a (partial) function in the meta-language that takes two arguments: a

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9 See Rawlins (2013) for a discussion of the notion of content and media artifact nouns, in the context of the disribution of the preposition *about*. Rawlins assumes that media artifact nouns do in fact denote predicates over contentful entities, and it is not immediately obvious how to reconcile this claim with the distribution of *that*-clauses. I leave a detailed study of media artifact nouns in light of the framework developed in this thesis to future work.

world w and an individual x. It returns the content of x in w as a proposition. The Kratzer/Moulton denotation is a function from an individual x to true, iff the function $CONT$ returns the proposition *that Shirley left* as the unique content of x in the world of evaluation w. The Kratzer/Moulton denotation is only defined for individuals x that are contentful in the world of evaluation w.

2.3.3 *Direct composition with content nouns*

Adopting the Kratzer/Moulton denotation accounts for the fact that a *that*-clause may compose with a content noun, on the assumption that content nouns also denote sets of individuals with propositional content. This is because two expressions of type $\langle e, t \rangle$ may combine via PM, as illustrated in (77). Note importantly that predicate CPs are labelled as $\mathcal{C}$Ps to distinguish them from ordinary CPs. I investigate the internal composition of the $\mathcal{C}$P in a later section.

(76)   Content noun denotation:
       $[\![\text{rumour}]\!] = \lambda w . \lambda x : x \in \text{dom}(CONT_w) . \text{rumour}_w(x)$

(77)   a.   [$_{\text{DP}}$ The rumour that Shirley left]

b. $\iota x \begin{bmatrix} \text{rumour}_w(x) \\ \wedge\, \mathcal{CONT}_w(x) \\ = \lambda w'\,.\, \text{S left in } w' \end{bmatrix}$

DP

$\lambda P\,.\,\iota x[P(x)]$ $\lambda x\,.\, \text{rumour}_w(x)$

the $\wedge\, \mathcal{CONT}_w(x)$

$= \lambda w'\,.\ \text{S left in } w'$

NP

$\lambda x\,.\, \text{rumour}_w(x)$ $\lambda x\,.\, \mathcal{CONT}_w(x)$

NP $= \lambda w'\,.\, \text{S left in } w'$

rumour$_w$ $\mathcal{C}\text{P}_w$

that Shirley left
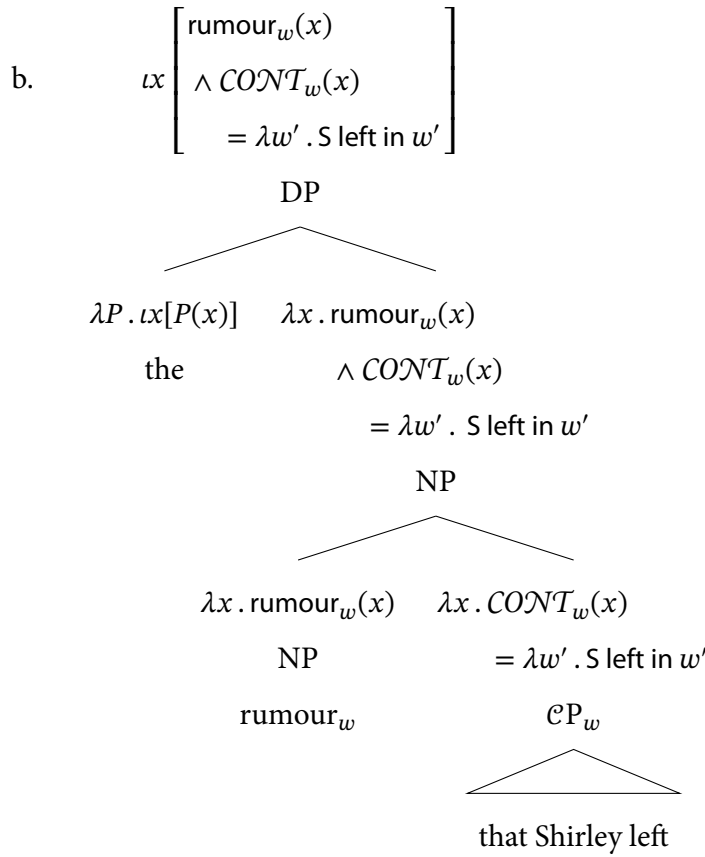
I assume that the (singular) definite article simply denotes Partee's (1986) *iota* operator, which takes a predicate *P* and returns the unique individual *x* such that $P(x)$, and is defined if there is such a unique individual. We correctly predict that the definite description *the rumour that Shirley left* denotes the unique individual *x*, such that *x* is a rumour in the world of evaluation *w*, and the content of *x* in *w* is the proposition that Shirley left.

2.3.4 *Late-merge*

One piece of evidence that *that*-clauses are modifiers of the nominals with which they compose, is that they pattern together with relative clauses with respect to *Williams' generalization* (see Moulton 2017 for discus-

sion). Williams' generalisation states that an extraposed adjunct marks the scope of the DP from which it is sub-extracted. This is illustrated for a relative clause modifier by the examples in (78) (Moulton 2017: 294).

(78) a. John dismissed every rumour that was spread
          before Mary did.   every > before / before > every

      b. John dismissed every rumour, before Mary did,
          that was spread.   every > before / *before > every

On Fox & Nissenbaum's (1999) view, extraposition involves late merging the relative-clause modifier to the unpronounced higher copy created by QR-ing the DP host. This is illustrated in (80). The result is well-typed, since the noun and the relative clause compose via PM (see Bhatt & Pancheva 2004 for an application of this idea to comparatives). The predicative account of Noun Complement Clauses (NCCs) predicts that they should pattern with relative clauses in this respect. Moulton (2017: p. 294) shows that this prediction is borne out (see Moulton's paper for more in-depth discussion of the kind of context needed to disambiguate between the wide and narrow scope readings of the quantificational DP).

(79) a. John dismissed every rumour that he was resigning,
          before Mary did.   every > before / before > every

      b. John dismissed every rumour, before Mary did,
          that he was resigning.   every > before / *before > every

(80) John dismissed every rumour, before Mary did,
      that he was resigning.

(81)

TP

DP ...

John ...

... ... DP₁

dismissed DP₁ before Mary did every NP

every rumour rumour 𝒞P

that he was resigning

2.4 *THAT*-CLAUSES IN THE VERBAL DOMAIN

2.4.1 *Events and individuals*

Throughout, I have used *e* as the name of a variable ranging over events, *s* as the name of a variable ranging over states, and *x*, *y*, etc. as the names of variables ranging over individuals. I have been deliberately non-specific as to whether or not this reflects a type distinction between eventualities and individuals. Authors working in event semantics differ here: it is common to assume that the model includes a distinct domain of individuals (D_e) and events (D_v). Others, such as Lasersohn (1995), assume that the model includes a single domain of entities (D_e), which includes individuals and eventualities as sorted sub-domains.

One consequence of the latter system is that there is no longer any type distinction between expressions ranging over eventualities, and those

ranging over other entities, as illustrated in the more explicit lexical entry for the verb *hit* in (82)[10].

(82) $[\![\text{hit}]\!] = \lambda w \in D_s \,.\, \lambda e \in D_e \,.\, \text{hitting}_w(e)$

Since assuming no type distinction been eventualities and other entities is quite uncommon in the literature, it is worth spending a little time motivating this idea. Predicates may impose various restrictions on their arguments. For example, the verb *love* does not tolerate an inanimate subject.

(83)   # This table loves me.

It is of course possible to give a *grammatical* explanation for this – perhaps expressions denoting animate entities, and those denoting inanimate entities are of different semantic types, e.g. e_a vs. e_i. We could then say that *love* is only defined for external arguments of type e_a. There is however a very plausible alternative explanation available which doesn't require us to complicate the grammar unnecessarily: as a matter of its lexical semantics, *love* presupposes that its external argument is capable of having a mental state. As a matter of world knowledge, we typically know that tables are incapable of holding mental states. The same reason can be extended to the distinction between eventualities and other individuals.

---

10 I remain agnostic here concerning the ontological status of *worlds*. For our purposes, it is sufficient to assume a distinct domain of worlds D_s in the model. Ultimately, I suspect that the full expressive power of natural language semantics necessitates only two semantic types: t, where D_t is the Boolean domain consisting of two values $\{0, 1\}$, where $0 \leq 1$, and e, where D_e is the non-Boolean domain of individual primitives, which includes individuals classically understood, eventualities, worlds, and moments (see Hallman 2009 for an account of aspect that assumes an ontology of primitive moments).
Relatedly, see Partee 2009, Liefke 2014 for speculative proposals that only one basic type is necessary for modelling natural language meaning.

(84)   a.   The run was long.

     b.   # The run was blonde.

    Positing a type distinction between eventualities and other individuals provides one with the apparatus to capture the infelicity of (84b) as a type-mismatch. This is arguably unnecessary, however, given that we typically know, as a matter of world knowedge, that running events do not have hair and therefore cannot be blonde.

2.4.2   *Contentful eventualities*

Following Kratzer (2006), Hacquard (2006) and Moulton (2009, 2015), I assume that the set of *contentful individuals* includes not just abstract objects such as *facts*, *stories*, and *theories*, but also *eventualities* such as *saying events*, *belief states*, etc.[11] What this means in practice is that, in a world of evaluation w, the domain X_c of $CONT_w$ (where $X_c \subseteq D_e$) is the set of contentful individuals.

    I assume that a speaker's semantic competence includes a list of meaning postulates of the following kind. (85) guarantees that all *facts* have content.[12]

(85)   For every individual in D_e and every world in D_s, the following holds:
$$\text{fact}_w(x) \to x \in \text{Dom}(CONT_w)$$

    We are now in a position to propose a minimal analysis of embedding *that*-clauses under attitude verbs. Once we allow for contentful eventualities, one straightforward consequence is that *that*-clauses, which we take

---

11 In order to draw a close parallel with existing work on the composition of *that*-clauses with nominals, I concentrate here on eventualities which, on an intuitive level, are associated with propositional content, although in a ch. 3, I enrich the notion of content in order to include individuals and eventualities with *inquisitive* content, such as *questions*, *wondering* events, etc.

12 Note that we will need to modify these meaning postulates slightly when modify the notion of 'content' from a Stalnakerian proposition to something richer in ch. 3.

to be of type $\langle e, t \rangle$, may combine with verbs via Predicate Modification. We illustrate this below for a simple speech report:

(86) Abed says that Shirley is upset.

(87)
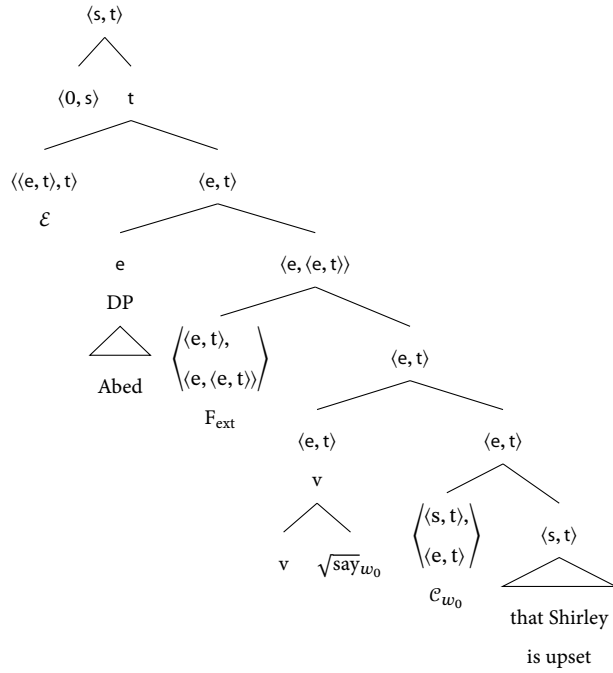
The computation goes as follows:

(88) a. $[\![\text{that Shirley is upset}]\!] = \lambda w'$. Shirley is upset in w'

  b. $[\![\mathcal{C}]\!](w_0) = \lambda p . \lambda x . CONT_{w_0}(x) = p$

  c. $(88\text{b})((88\text{a})) = \lambda x . CONT_{w_0}(x)$
  $= \lambda w'$. Shirley is upset in w'

  d. $[\![\sqrt{\text{say}}]\!](w_0) = \lambda e . \text{saying}_{w_0}(e)$

  e. $\text{PM}(88\text{c})(88\text{d}) = \lambda e . \text{saying}_{w_0}(e)$
  $\wedge CONT_{w_0}(e)$
  $= \lambda w'$. Shirley is upset in w'

f. $[\![F_{ext}]\!](w_0) = \lambda f . \lambda x . \lambda e . \mathcal{AG}_{w_0}(e) = x$

$\wedge f(e)$

g. $(88f)((88e)) = \lambda x . \lambda e . \mathcal{AG}_{w_0}(e) = x$

$\wedge \text{ saying}_{w_0}(e)$

$\wedge \mathcal{CONT}_{w_0}(e)$

$= \lambda w' . \text{Shirley is upset in } w'$

h. $[\![\text{Abed}]\!] = \text{Abed}$

i. $(88g)((88h)) = \lambda e . \mathcal{AG}_{w_0}(e) = \text{Abed}$

$\wedge \mathcal{CONT}_{w_0}(e)$

$= \lambda w' . \text{Shirley is upset in } w'$

j. $[\![\mathcal{E}]\!] = \lambda f . \exists e[f(e)]$

k. $(88j)((88i)) = \exists e \begin{bmatrix} \mathcal{AG}_{w_0}(e) = \text{Abed} \\ \wedge \text{ saying}_{w_0}(e) \\ \wedge \mathcal{CONT}_{w_0}(e) = \text{Shirley is upset} \end{bmatrix}$

l. $\lambda w . [\![88k]\!]^{0 \to w}$

$= \lambda w . \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Abed} \\ \wedge \text{ saying}_w(e) \\ \wedge \mathcal{CONT}_w(e) = \text{Shirley is upset} \end{bmatrix}$

I would like to propose that, quite generally, the mode via which a *that*-clause is Predicate Modification (PM). Predicates that embed *that*-clauses range over contentful entities, be they events or individuals, and *that*-clauses are modifiers which provide *content*. The Logical Form for the speech report, therefore, is paralleled by the Logical Forms assigned to belief reports, desire reports, etc.

2.4.3 *Deriving substitution failures*

With the neo-Davidsonian approach to clausal embedding in place, the meaning alternations we observed with the verb *explain* simply fall out as a result of how semantic composition *must* proceed. The fact that an embedded *that*-clause is *always* interpreted as the *explanans* becomes part of a broader generalization that a *that*-clause embedded under a verb always contributes the propositional content of the eventuality introduced by the verb.

Consider the LF for the explanans reading in (90). Since the embedded clause denotes a predicate, it must compose with the verbal root via PM. Therefore, the meaning contribution of the *that*-clause is to specify the content of the *explaining* event.

(89)   Angela explained that Boris resigned.

(90)

$\langle s, t \rangle$
- λw t
  - $\langle et, t \rangle$ — $\mathcal{E}$
  - $\langle e, t \rangle$
    - e — DP — Angela
    - $\langle e, et \rangle$
      - $\langle et, \langle e, et \rangle \rangle$ — $F_{ext,w}$
      - $\langle e, t \rangle$
        - $\langle e, t \rangle$ — $explain_w$
        - $\langle e, t \rangle$
          - $\langle st, et \rangle$ — $\mathcal{C}_w$
          - $\langle s, t \rangle$ — CP — that Boris resigned
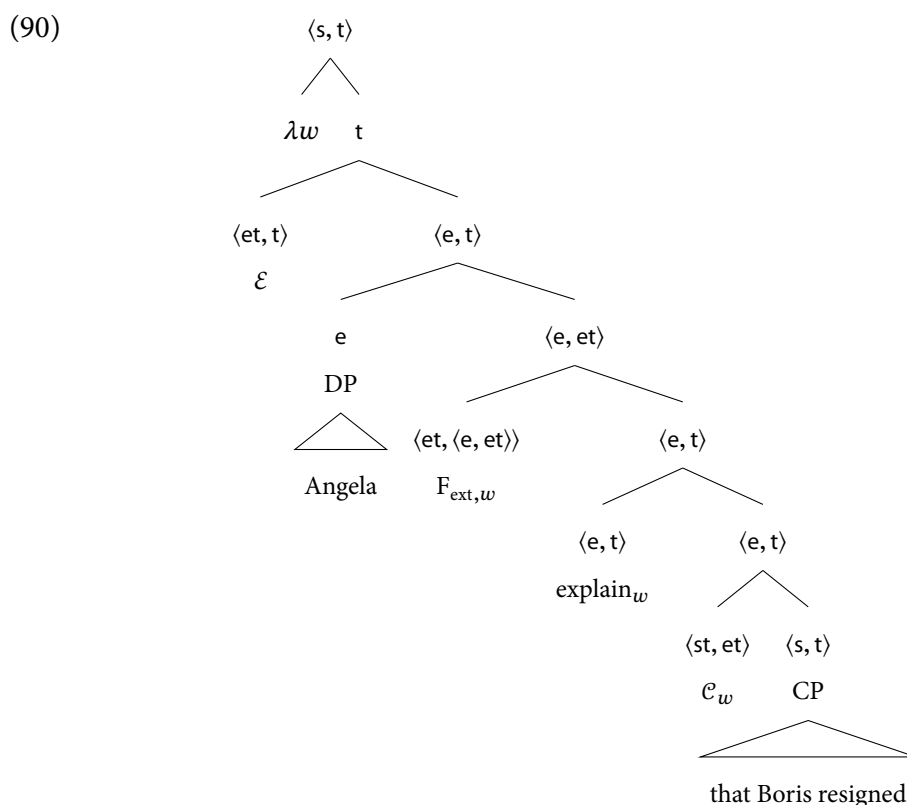
(91) $[\![\mathrm{F_{ext}}]\!] \leftrightarrow \lambda w \,.\, \lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{AG}_w(e) = x \wedge f(e)$

$\quad\quad / \underline{\quad\quad} \,[\, \mathrm{v} \sqrt{\mathrm{explain}} \,]$

(92) $\lambda w \,.\, \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \mathsf{Angela} \\ \wedge \; \mathsf{explaining}_w(e) \\ \wedge \; \mathcal{CONT}_w(e) = \mathsf{that\ Boris\ resigned} \end{bmatrix}$

A predicative $\mathcal{C}$P simply cannot compose with as the internal argument of $\sqrt{\mathrm{explain}}$, due to the way that argument introducing heads are typed. This is illustrated in (94).[13]

(94)
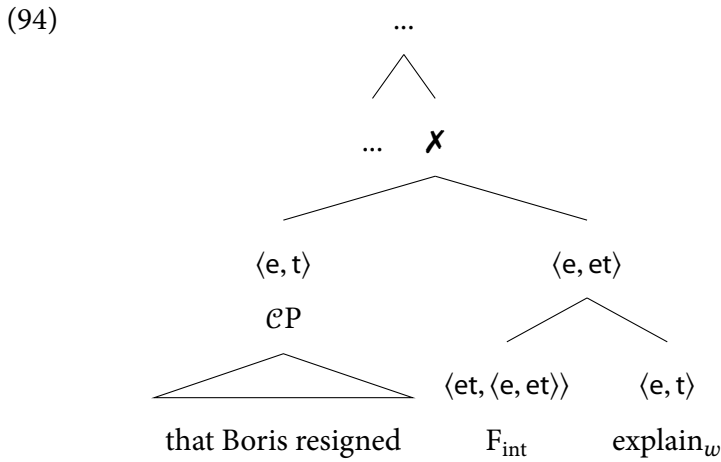
Recall that CONTDP denote individuals of type e.

---

13 Unlike Kratzer 2006, Moulton 2014, I do not assume that Chung & Ladusaw's (2004) RESTRICT is one of the basic rules of semantic composition, at least for English. RESTRICT would allow a predicative $\mathcal{C}$P to compose with a constituent of type $\langle e, et \rangle$. Another possibility which must be ruled out is an application of Partee's (1986) *iota operator*, which shifts expressions of type $\langle e, t \rangle$ to expressions of type e, and is defined in (93). The iota operator, in set talk, is defined only for singleton sets, and returns their unique member.

(93) $\iota_{\langle\langle\sigma,t\rangle,\sigma\rangle} = \lambda P \,.\, x$
Defined iff $\exists! x'[P(x')]$

I argue in a subsequent chapter that the iota operator may not be freely inserted to repair a type-mismatch, but rather the availability of iota is mediated by the syntax.

(95) ⟦the fact that Boris resigned⟧

$$= \iota x \begin{bmatrix} \mathsf{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) = \text{that Boris resigned} \end{bmatrix}$$

Due to typing, a ContDP may compose with a verbal denotation via FA, as illustrated in (96), but this leads to a subsequent type-mismatch due to the typing of argument taking heads.

(96)
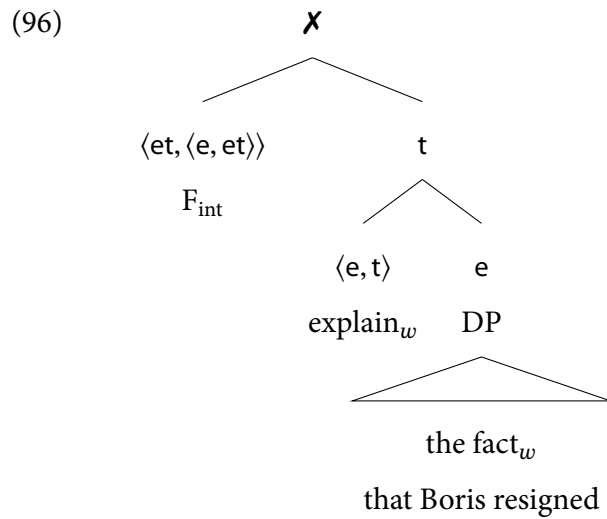
Due to the way that the system is set up, type e expressions must be integrated at LF as the specific of an argument taking head. The LF for the explanandum reading is given in (97).

(97) $\lambda w \,.\, \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Angela} \\ \\ \wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix} \\ \\ \text{explaining}_w(e) \end{bmatrix}$

$\lambda w \qquad \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Angela} \\ \\ \wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix} \\ \\ \text{explaining}_w(e) \end{bmatrix}$

$\mathcal{E} \quad 1 \text{ iff } \lambda e \,.\, \mathcal{AG}_w(e) = \text{Angela}$
$\wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix}$
$\text{explaining}_w(e)$

$\text{Angela} \quad \lambda y \,.\, \lambda e \,.\, \mathcal{AG}_w(e) = y$
DP $\qquad\qquad \wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix}$
Angela $\qquad\qquad \text{explaining}_w(e)$

$\text{F}_{\text{ext},w} \quad \lambda e \,.\, \mathcal{TH}_w(e)$
$= \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix}$
$\wedge \, \text{explaining}_w(e)$

① $\qquad\qquad\qquad \lambda x \,.\, \lambda e \,.\, \mathcal{TH}_w(e)$
$\iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{B resigned} \end{bmatrix} \qquad = x$
$\qquad\qquad\qquad \wedge \, \text{expaining}_w(e)$

$\lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{TH}_w(e) \quad \lambda e \,.\, \text{explaining}_w(e)$
$= x \qquad\qquad \text{explain}_w$
$\wedge \, f(e)$
$\text{F}_{\text{int},w}$

79

(98)

$$① \\ \iota x \begin{bmatrix} \mathsf{fact}_w(x) \\ \wedge\ \mathcal{CONT}_w(x) \\ =\ \mathsf{B\ resigned} \end{bmatrix}$$

DP

ι $\lambda x\,.\,\mathsf{fact}_w(x)$

the $\wedge\ \mathcal{CONT}_w(x) = \mathsf{B\ resigned}$

$\lambda x\,.\,\mathsf{fact}_w(x)$ $\lambda x\,.\,\mathcal{CONT}_w(x) = \mathsf{B\ resigned}$

fact_w

$\lambda p\,.\,\lambda x\,.\,\mathcal{CONT}_w(x) = p$ B resigned

$\mathcal{C}_w$

that Boris resigned

(99) $[\![\mathrm{F}_{\mathrm{int}}]\!] \leftrightarrow\, = \lambda w\,.\,\lambda f\,.\,\lambda x\,.\,\lambda e\,.\,\mathcal{TH}_w(e) = x \wedge f(x)\ /\ \underline{}\ \sqrt{\mathstrut}\mathrm{explain}$

The interpretation of a thematic argument relative to a verbal root *can* be idiosyncratic. As such, this account of subtitution failures fails to *guarantee* that an embedded contDP receives a distinct interpretation to an embedded *that*-clause. A putative case of such a verb is *believe*. Note that (100b) entails (100a), but not vice versa.

(100)   a.   Abed believes that Jeff is balding.

        b.   Abed believes the rumour that Jeff is balding.

(101) $[\![\mathrm{F}_{\mathrm{int}}]\!] \leftrightarrow \lambda w\,.\,\lambda f\,.\,\lambda x\,.\,\lambda e\,.\,\mathcal{CONT}_w(e) = \mathcal{CONT}_w(x)$

          $/\ \underline{}\ \sqrt{\mathstrut}\mathrm{belief}$

(102) $\lambda w . \exists s \begin{bmatrix} \mathcal{HOLDER}_w(s) = \text{Abed} \\ \wedge \text{ belief}_w(s) \\ \wedge \mathcal{CONT}_w(s) \\ \quad = \mathcal{CONT}_w(\iota x \begin{bmatrix} \text{rumour}_w(x) \\ \wedge \mathcal{CONT}_w(x) = \text{J is balding} \end{bmatrix}) \end{bmatrix}$

According to the Logical Form predicted by the account outlined here, (100b) ends up entailing (100a) (so long as its presupposition is satisfied), but not vice versa, since (100b) is partial proposition, with the presupposition that there exists a unique rumour, with the content that Jeff is balding.[14]

2.5 NOMINALISATIONS

The account of substitution failures outlined here makes an interesting prediction – there is no reason why roots such as $\sqrt{\text{explain}}$, which may optionally take an internal argument, cannot simultaneously occur with both a nominal argument interpreted as a *theme*, and a *that*-clause interpreted as a *content*. It turns out, however, that this is ungrammatical.

---

14 Note that this account predicts that (100a) will also entail (100b) just in case the presupposition of (100b) is satisfied. I am unsure as to whether or not this is a good prediction. Imagine the following scenario: Klaus believes that Patrick is moving to Berlin. Unbeknownst to Klaus, there is a rumour going around the other PhD students that Patrick is moving to Berlin. Klaus hasn't heard this rumour and is unaware that it exists. Is it true, in such a scenario, that *Klaus believes the rumour that Patrick is moving to Berlin*? My own judgement is that there is at least a reading of this sentence under which it *is* true, in which case the analysis outlined here seems to make a good prediction. It seems conceivable however, that speakers may only judge this sentence felicitous if the rumour is the source of Klaus' belief. In this case, we can assume that F_{int} has the following interpretation in the context of $\sqrt{\text{belief}}$:

(103) $[\![F_{\text{int}}]\!] = \lambda w . \lambda f . \lambda x . \lambda e . \mathcal{CONT}_w(e) = \mathcal{CONT}_w(e)$
$\wedge f(e)$
$\wedge \mathcal{SOURCE}(e) = x$

(104) a. *Angela explained [$_{DP}$ the fact that Boris resigned]
       [$_{CP}$ that his wife was ill].

   b. *Angela explained [$_{CP}$ that his wife was ill]
       [$_{DP}$ the fact that Boris resigned].

The Logical Forms that we would expect for such sentences express perfectly sensible and coherent propositions, so a semantic/pragmatic explanation for this unexpected fact is not forthcoming.

$$(105) \quad \lambda w \,.\, \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Angela} \\ \wedge \; \text{explaining}_w(e) \\ \wedge \; \mathcal{CONT}_w(e) = \text{B's wife was ill} \\ \wedge \; \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \; \mathcal{CONT}_w(x) = \text{B resigned} \end{bmatrix} \end{bmatrix}$$

In this section, I will argue that the source of the ungrammaticality of the examples in (104) is syntactic, and that, in fact the *theme* and *content* can co-occur in other environments. Over the course of this argument, I will also criticise Moulton's (2014) theory of nominalisation, and propose a new account of nominalisation with superior empirical coverage.

2.5.1 *Background*

Grimshaw 1990 argues for a general partition of nominalisations into Complex Event Nominal s (CENs), Simple Event Nominals (SENs), and Result Nominals (RNs). Certain nominals such as *examination* are ambiguous between a CEN, SEN, and a RN. This is illustrated below. Intuitively, both the CEN and SEN pick out examining events, but differ according to whether or not an internal argument is present. The RN on the other hand picks out a physical object relating to the examining event.

(106) a. The examination of the students lasted a long time. CEN

  b. The examination lasted a long time. SEN

  c. The examination was photocopied on green paper. RN

(Moulton 2014: 122)

The different varieties of nominal can be distinguished on the basis of a number of diagnostics:

(107)

	___ take place	poss = agent	int. arg.	*frequent/constant*	aktionsart
CEN	✓	✓	✓	✓	✓
SEN	✓	✗	✗	✓	✗
RN	✗	✗	✗	✗	✗

I won't go through all of these diagnostics, but concentrate only on the final cell, which poses the central theoretical puzzle here. Both CENs and SENs, in contrast to RNs are eventive. Where CENs differ from SENs is in the presence of argument structure. This is significant, in that it correlates with the availability of aktionsart modifiers such as *in/for days*. This is illustrated below for *construction*.

(108) a. Construction of buildings in/for days bothered everyone.

✓CEN

  b. *Construction for in/for days bothered everyone.

✗SEN

  c. *The construction in/for days was widespread.

✗RN

2.5.2 *Moulton's (2014) analysis*

Moulton's (2014) central theoretical claim is that roots can be specified as internal-argument taking (Kratzer 1996, Harley 2014, but see Alexiadou

2014, Lohndal 2014 for arguments against this contention). This of goes goes against the general picture argued for in this thesis. The external argument is taken to be severed and introduce via functional material.

(109) $[\![\sqrt{\text{examine}}]\!] = \lambda w \,.\, \lambda x \,.\, \lambda e \,.\, \text{examine}_w(x, e)$

Moulton's analysis of the patterns of nominalisation outlined above is as follows: CENs are nominalised verbal projections, whereas SENs and RNs involve two different existential closure operators.

(110) a. assignment of the exam was swift.

    b. $\lambda e \,.\, \text{assign}(\text{theExam}, e)$

nP

$\lambda a \,.\, a$ $\lambda e \,.\, \text{assign}(\text{the Exam}, e)$

n

-ment $\lambda x \,.\, \lambda e \,.\, \text{assign}(x, e)$ theExam

$\sqrt{\text{assign}}$ PP

of the exam
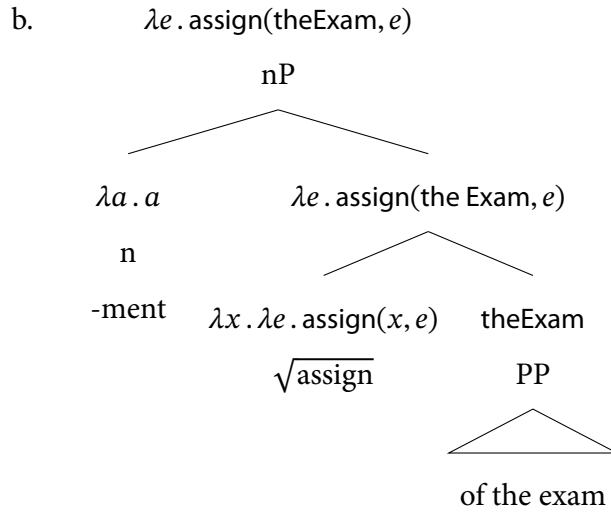
(111) $[\![\exists_{\text{RN}}]\!] = \lambda P_{\langle e, \langle v, t \rangle \rangle} \,.\, \lambda x \,.\, \exists e[P(x)(e)]$

(112) a. The assignment was written on green paper.

    b. $\lambda x \,.\, \exists e[\text{assign}(x, e)]$

$\lambda P \,.\, \lambda x \,.\, \exists e[P(x)(e)]$ $\lambda x \,.\, \lambda e \,.\, \text{assign}(x, e)$
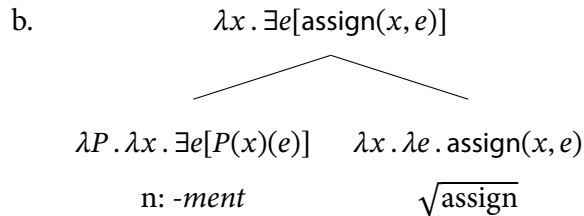
n: *-ment* $\sqrt{\text{assign}}$

(113) $\llbracket\exists_{\text{SEN}}\rrbracket = \lambda P_{\langle e,\langle v,t\rangle\rangle} \,.\, \lambda e \,.\, \exists x[P(x)(e)]$

(114) a. | Assignment | was swift.

    b. $\lambda e \,.\, \exists x[\text{assign}(x,e)]$

    $\lambda P_{\langle e,\langle v,t\rangle\rangle} \,.\, \lambda e \,.\, \exists x[P(x)(e)]$ $\lambda x \,.\, \lambda e \,.\, \text{assign}(x,e)$

                n: *-ment* $\sqrt{\text{assign}}$
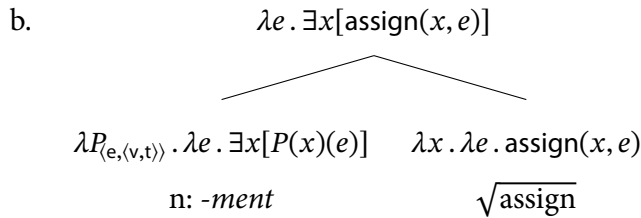
Aktionsart modifiers are assumed to be special for the following reason: they must be first-merged in the specifier position of a functional head AKT^0. Semantically, AKT^0 is the identity function over $D_{\langle v,t\rangle}$.

(115) $\llbracket\text{AKT}^0\rrbracket = \lambda f_{\langle v,t\rangle} \,.\, f$

The core of Moulton's explanation for the correlation between the presence of an internal argument and the availability of an aktionsart modifier, is that, due to the way that AKT^0 is typed, the internal argument of the root must be saturated before composition can proceed.

(116)   ...

            n $\langle v,t\rangle$

        -tion

                    $\langle v,t\rangle$ $\langle v,t\rangle$

            in two hours $\langle vt,vt\rangle$ $\langle v,t\rangle$

                            AKT^0

                                    $\langle e,\langle vt\rangle\rangle$ e

                                    $\sqrt{\text{examine}}$ PP

85
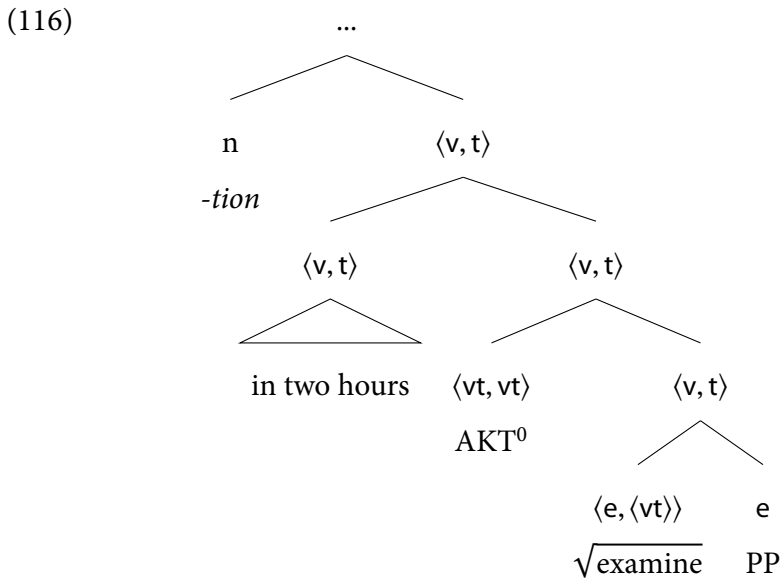
The LFs in (117) and (118) illustrate how Moulton derives the incompatibility between aktionsart modifiers and SENs. There are two putative derivations which we might want to consider. In the first, AKT^0 merges directly with the roo $\sqrt{\text{examine}}$. Due to way that AKT^0 is typed, this leads to a type mismatch, since $[\![\sqrt{\text{examine}}]\!]$ has an unsaturated internal argument. In the second putative derivation, the internal argument is saturated, followed by merge of AKT^0 and an aktionsart modifier. This leads to a type mismatch with $\exists_{SEN}$ however, which is defined as abstracting over the unsaturated internal argument of the root. The final logical possibility, not illustrated here, is that AKT^0 merges after $\exists_{SEN}$. This would be well-typed, but Moulton assumes that AKT^0 may only merge with a verbal extended projection.

(117)

$$
\begin{array}{cc}
& ✗ \\
\swarrow & \searrow \\
\langle vt, vt \rangle & \langle e, vt \rangle \\
AKT^0 & \sqrt{\text{examine}}
\end{array}
$$

(118)

$$
\begin{array}{cc}
& ✗ \\
\langle \langle e, vt \rangle, vt \rangle & \langle v, t \rangle \\
\exists_{SEN} & \\
& \langle v, t \rangle \quad \langle v, t \rangle \\
& PP \\
& \langle vt, vt \rangle \quad \langle v, t \rangle \\
& AKT^0 \\
& \langle v, t \rangle \quad e \\
& \sqrt{\text{examine}} \quad PP
\end{array}
$$
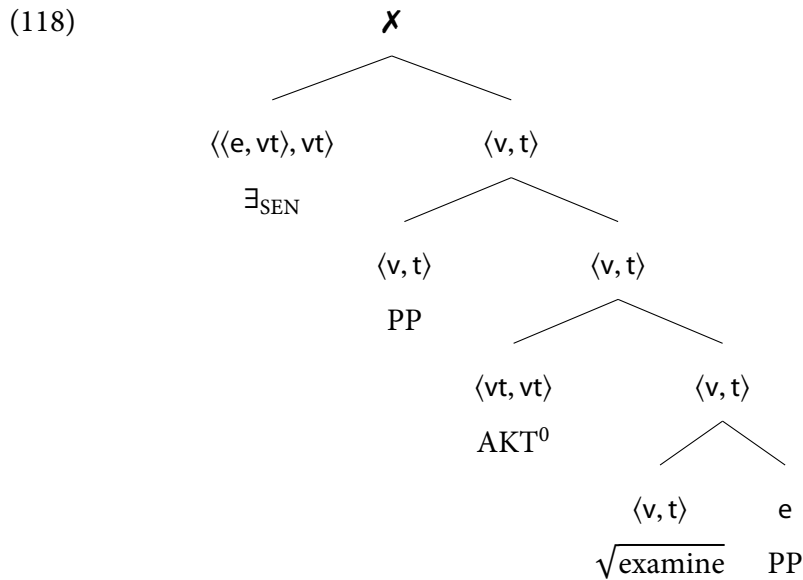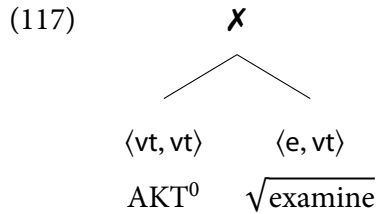
2.5.3 *Nominalizations of clause-taking roots*

Moulton (2014) extends the theory of nominalization outlined above to clause-taking roots, arguing that it provides additional support for the conjecture that roots take internal arguments. As we shall say, it will end up making some problematic predictions, which can be rectified on the basis of the approach to clausal embedding outlined here.

Clause-taking roots, such as $\sqrt{\text{explain}}$ can be both RNs and SENs, as illustrated by the examines in (120) and (119) respectively.

(119)   Nathan's explanation lasted way too long.

(120)   Nathan's explanation was that Naomi is here.

Moulton's (2014) core observation is that *that*-clauses fail to pattern with other internal arguments with respect to licensing aktionsart modifiers. Moulton constructs minimal pairs on the basis of the root $\sqrt{\text{observe}}$, which can compose with both nominals and *that*-clauses.

(121)   a.   We observed [$_{DP}$ the gorilla's behaviour] for a month.

    b.   Observation *(of [$_{DP}$ the gorilla's behaviour]) for a month was necessary.

(122)   a.   We observed [$_{CP}$ that the gorilla was behaving erratically] for a month.

    b.   *Our observation ([$_{CP}$ that the gorilla was behaving erratically]) for a month was necessary.

Moulton's putative generalization is that nominals that compose directly with *that*-clauses are *never* CENs, and this is independent of the presence of nominalising morphology. Some examples below:

(123)   a.   John whispered for five minutes that we should leave together.

    b.   *John's whisper for five minutes that we should leave together.

(124) a. Nathan discovered in half an hour that Henning was lying.

  b. *Nathan's discovery in half an hour that Henning was lying.

  c. Nathan's discovery of Henning's deception in only half an hour was incredible.

Moulton argues that the inability of clause-taking roots to form CENs constitutes an additional argument that roots must be specified as internal argument taking. The details of Moulton's analysis is as follows; just as here, Moulton assumes a predicative semantics for *that*-clauses, repeated below for convenience.

(125) $[\![\mathcal{C}_w \text{ that Henning was lying}]\!]$

$= \lambda x . \mathcal{CONT}_w(x)$

$= \lambda w' . \text{H was lying in } w'$

Moulton assumes that *that*-clauses compose with clause-taking roots, typed as $\langle e, \langle v, t \rangle \rangle$ via Chung & Ladusaw's (2004)'s RESTRICT, the definition of which is given below.

(126) RESTRICT (Chung & Ladusaw 2004)

$$\left[\!\!\left[\begin{array}{c} \alpha \\ \bigwedge \\ \beta \quad \gamma \end{array} \right]\!\!\right] = \lambda x . [\![\beta]\!](x) \wedge [\![\gamma]\!](x) \qquad [\![\beta]\!] \in D_{\langle e, \langle v, t \rangle \rangle} \wedge [\![\gamma]\!] \in D_{\langle e, t \rangle}$$

This enables a *that*-clause to compose with a clause-taking root in the following way. Observe that $\mathcal{C}$P and $\sqrt{\text{explain}}$ compose via RESTRICT, as defined in (126)

(127)

$$\lambda x . \lambda e . \text{explaining}_w(e)$$
$$\wedge \, \mathcal{CONT}_w(x)$$
$$= \lambda w' . \text{H is upset in } w'$$

$\lambda x . \lambda e . \text{explaining}_w(e)$ $\lambda x . \mathcal{CONT}_w(x)$

$\sqrt{\text{explain}_w}$ $= \lambda w' . \text{H is upset in } w'$

$\mathcal{C}\text{P}$

$\lambda p . \lambda x . \mathcal{CONT}_w(x)$ $\lambda w' . \text{H is upset in } w'$

$= \lambda w' . \text{H is upset in } w'$ CP

$\mathcal{C}_w$

that Henning is upset
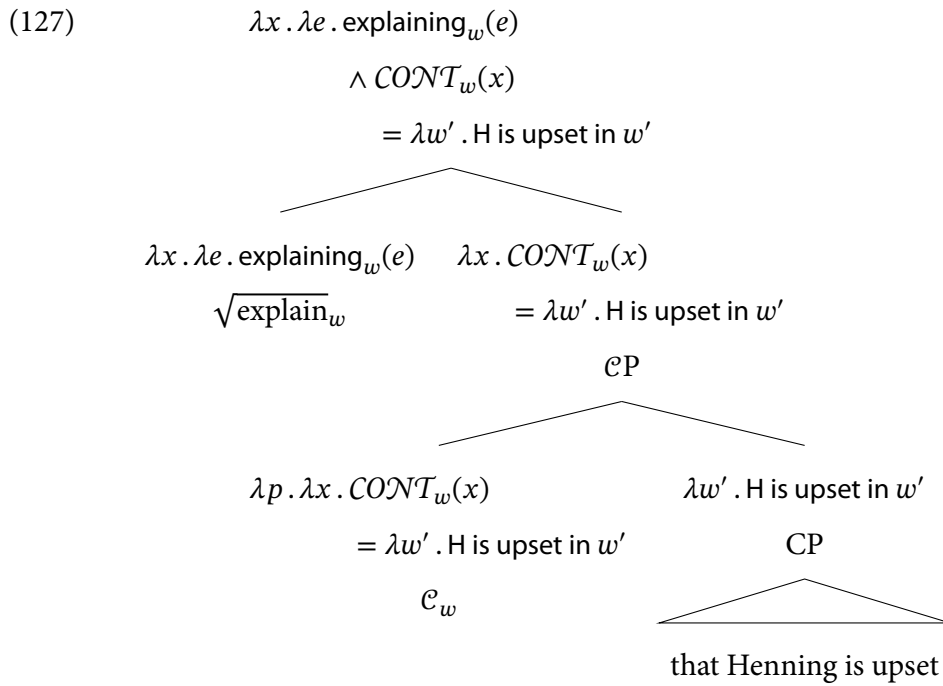
This account of *that*-clause composition accurately predicts that nominal and clausal arguments should behave in a distinct fashion when it comes to licensing aktionsart modifiers with nominalisations. Nominal arguments *saturate*, whereas clausal arguments RESTRICT.

(128)

✗

$\langle \text{vt}, \text{vt} \rangle$ $\langle \text{e}, \langle \text{v}, \text{t} \rangle \rangle$

AKT^0

$\langle \text{e}, \langle \text{v}, \text{t} \rangle \rangle$ $\langle \text{e}, \text{t} \rangle$

$\sqrt{\text{explain}}$ $\mathcal{C}\text{P}$

that Henning is upset
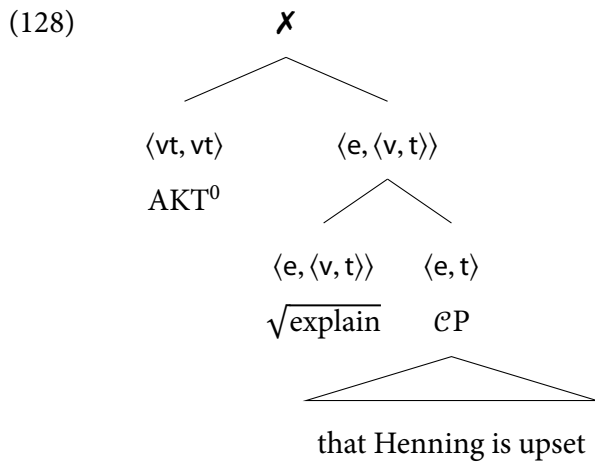
Moulton's account falls short however. There is a sizable class of clause-taking roots which may not compose with a content DP, such as $\sqrt{\text{promise}}$.

(129)   a.   Nathan promised [$_{\text{CP}}$ that he would arrive on time].

        b.   *Nathan promised [$_{\text{DP}}$ the claim that he would arrive on time].

        c.   Nathan's promise that he would arrive on time.

        d.   *Nathan's promise of the claim that he would arrive on time.

If $\sqrt{\text{promise}}$ is typed as $\langle e, \langle v, t \rangle \rangle$, we wrongly predict that it should be possible to compose $\sqrt{\text{promise}}$ and a CONTDP. Alternatively, Moulton could type $\sqrt{\text{promise}}$ as $\langle v, t \rangle$, but in Moulton's system there is simply no obvious way of composing a root of type $\langle v, t \rangle$ with a *that*-clause of type $\langle e, t \rangle$. One possible way out for Moulton here would be to claim that $\sqrt{\text{promise}}$ doesn't assign case, which would account for the ungrammaticality of (129b) while allowing Moulton to maintain that $\sqrt{\text{promise}}$ has an individual argument slot. This is clearly incorrect however, on the basis of examples such as (130). Furthermore, it is standardly assumed that *of* is a case-assigner in (129d).

(130)   Nathan promised that he would arrive on time, and Anna promised [$_{\text{DP}}$ the same thing].

Intuitively, the reason that Moulton's system falls short here is that it confounds the ability to compose with a contentful entity-denoting argument with the ability to compose with a *that*-clause. On Moulton's account, the argument slot saturated by the contentful individual is that one restricted by the *that*-clause. The prediction of Moulton's account therefore, which is obviously incorrect, is that modulo case, a root may compose with a *that*-clause iff it can compose with a contentful entity-denoting nominal.

Even more problematically, for some roots such as $\sqrt{\text{explain}}$, which may indeed compose with both a CONTDP and a *that*-clause, both may co-occur with the nominalised form. Consier the example in (131), where

$\sqrt{\text{explain}}$ composes with a nominal argument, and is predicated of a *that*-clause. The LF predicted by Moulton is given in (132). Moulton simply predicts that this shouldn't compose – the internal argument of $\sqrt{\text{explain}}$ has already been saturated, so there is nothing for the *that*-clause to restrict. (131) is however acceptable.

(131)   Deckard's explanation of [$_{DP}$ the fact that Rachel is distant]
        is [$_{DP}$ that she is an android].

(132)

$$\iota e \begin{bmatrix} \text{explaining}_w(e, \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge\ \mathcal{CONT}_w(x) \\ = \text{R is distant} \end{bmatrix}) \\ \wedge\ \mathcal{AG}_w(e) = \text{Deckard} \end{bmatrix}$$

DP: Deckard's explanation of the fact that Rachel is distant

$\lambda x\,.\,\mathcal{CONT}_w(x)$ = R is an android

is ...

$\mathcal{C}_w$ CP: that she is an android
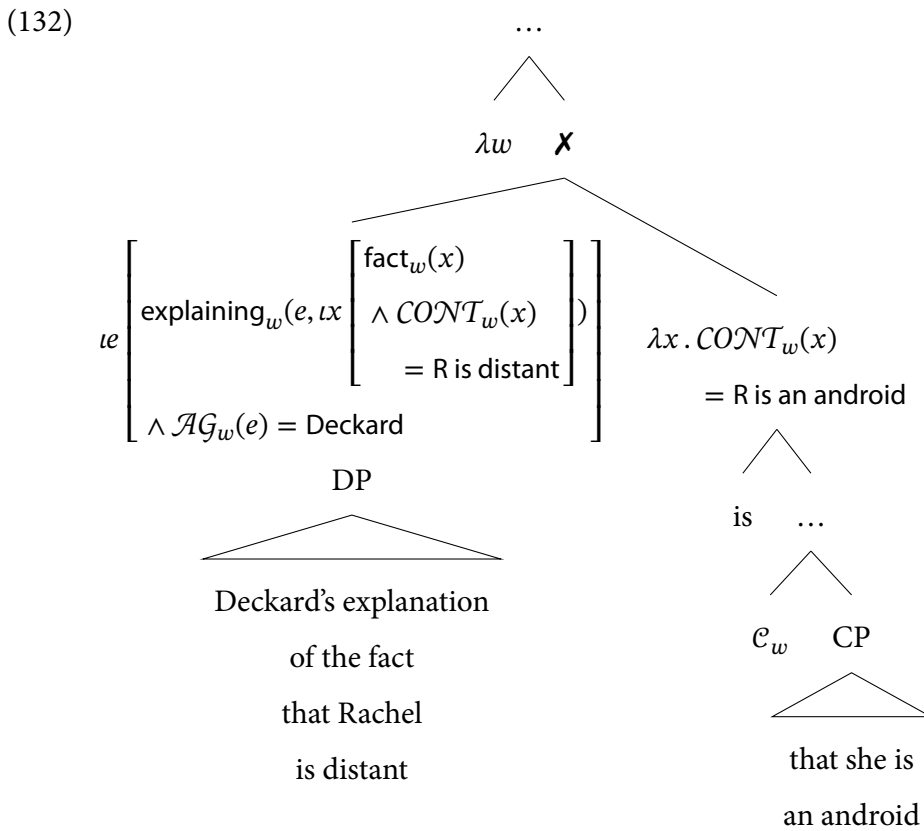
Moulton's system fairs a little better for examples such as (133), where the root composes with both a *that*-clause and a nominal.[15][16] The mean-

---

15 Crucially, in Moulton's system, if a root is to compose with both a nominal and a *that*-clause, the *that*-clause must compose before the nominal. This is because *that*-clauses restrict, and nominals saturate. Saturation can follow restriction but not vice versa.

16 This is of course only a toy denotation for possessive 's.

ing we end up with in (135) carries the presupposition in (134). Since *CONT* is a *function* for Moulton too, there is no individual that can satisfy the final conjunct, since R is distant and R is an android are distinct propositions.

(133)   I was unconvinced by Deckard's explanation
[$_{CP}$ that Rachel is an android]
for [$_{DP}$ the fact that she is distant]

$$(134) \quad \exists!e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Deckard} \\[2ex] \text{explaining}(e, \iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge\, CONT_w(x') \\ = \text{R is distant} \end{bmatrix}) \\[4ex] \wedge\, CONT_w(\iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge\, CONT_w(x') \\ = \text{R is distant} \end{bmatrix}) \\[4ex] = \text{R is an android} \end{bmatrix}$$

(135) ιe

$$\begin{bmatrix} \mathcal{A}\mathcal{G}_w(e) = \text{Deckard} \\ \text{explaining}(e, \iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge CONT_w(x') \\ = \text{R is distant} \end{bmatrix}) \\ \wedge CONT_w(\iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge CONT_w(x') \\ = \text{R is distant} \end{bmatrix}) \\ = \text{R is an android} \end{bmatrix}$$

DP   …

Deckard

$\lambda f . \lambda x . \iota e \begin{bmatrix} \mathcal{A}\mathcal{G}_w(e) \\ = x \\ \wedge f(e) \end{bmatrix}$

's

…

$\lambda p . p$ $\lambda e . \text{explaining}_w(e, \iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge CONT_w(x') \\ = \text{R is distant} \end{bmatrix})$

n

-tion $\wedge CONT_w(\iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge CONT_w(x') \\ = \text{R is distant} \end{bmatrix})$

$= \text{R is an android}$

$\iota x' \begin{bmatrix} \text{fact}_w(x') \\ \wedge CONT_w(x') \\ = \text{R is distant} \end{bmatrix}$ $\lambda x . \lambda e . \text{explaining}_w(e, x)$

$\wedge CONT_w(x)$

PP $= \text{R is an android}$

for the fact $\lambda x . CONT_w(x)$ $\lambda x . \lambda e . \text{explaining}_w(e, x)$

that she $= \text{R is an android}$ $\sqrt{\text{explain}_w}$

is distant eP

that Rachel

is an android

2.5.4 *New analysis*

I would like to suggest that there is no real distinction in kind between
SENs and CENs – both kinds of nominal simply involve a semantically
eventive, syntactically nominal structure. I will group them, therefore,
under a single heading as Event Nominals (ENs). The system we have

set up for accounting for clausal embedding can immediately account for the two examples which were problematic for Moulton, repeated below.

(136) a. Deckard's explanation of the fact that Rachel is distant is that she is an android.

   b. I was unconvinced by Deckard's explanation that Rachel is an android for the fact that she is distant.

(137)

$$\lambda w \,.\, \mathcal{CONT}_w(\iota e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Deckard} \\ \wedge \text{ explaining}_w(e) \\ \\ \wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{R is distant} \end{bmatrix} \end{bmatrix})$$

$$= \text{that R is an android}$$

$$\begin{array}{c} \diagup\!\diagdown \\ \lambda w \quad \dots \end{array}$$

$$\iota e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Deckard} \\ \wedge \text{ explaining}_w(e) \\ \\ \wedge \, \mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{R is distant} \end{bmatrix} \end{bmatrix} \qquad \begin{array}{c} \lambda x \,.\, \mathcal{CONT}_w(x) \\ = \text{R is an android} \end{array}$$

$$\text{was} \qquad \text{CP}$$

$$\text{Deckard} \quad \dots \qquad\qquad \text{that she}$$

$$\text{is an android}$$

$$\text{'s} \quad \lambda e \,.\, \text{explaining}_w(e)$$

$$\mathcal{TH}_w(e) = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \mathcal{CONT}_w(x) \\ = \text{R is distant} \end{bmatrix}$$

$$\text{n} \quad \langle e, t \rangle$$

$$\text{e} \qquad\qquad \langle e, et \rangle$$

$$\text{PP}$$

$$\qquad\qquad \langle et, \langle e, et \rangle \rangle \quad \langle e, t \rangle$$

$$\text{for the fact} \qquad \text{F}_{\text{int}}$$

$$\text{that Rachel is distant} \qquad\qquad \text{v} \quad \sqrt{\text{explain}}$$

Note especially that the system we have developed here does not rule out the possibility of a *theme* (in the form of a nominal argument), and a *content* (in the form of a *that*-clause) from co-occuring. We saw however that this was ruled out in the verbal domain.

(138)   a.   *Deckard explained the fact that Rachel is distant that she is android.

   b.   *Deckard explained that Rachel is an android the fact that she is distant.

In the nominal domain however, observe that the *theme* and *content* *can* co-occur, suggesting that it is not the semantics but rather the syntax that is responsible for the ungrammaticality of the examples in (138).

2.6   BEYOND 'EXPLAIN'

Not all clause-taking roots which give rise to substitution failures exhibit similar behaviour to explain, in that they allow a *theme* and *content* to be realized simultaneously in the nominal domain. Consider for example *see*.

(139)   a.   Shirley saw [$_{CP}$ that Jeff was upset].

   b.   #Shirley saw [$_{DP}$ the fact that Jeff was upset].

   c.   Shirley saw Jeff.

Unlike *explain*, *see* is clearly polysemous. (139a) can be paraphrased as: *Shirley inferred (from something) that Jeff was upset.*. (139c) on the other hand can be paraphrased as: *Jeff was in Shirley's field of vision*. We can see that (139a) entails nothing about the subject's vision, based on the example in (140). (140) is completely felicitous in a context where the subject is blind (and hence incapable of *seeing* in the visual sense), but is in a position where he can infer the truth of proposition denoted by the embedded CP.

(140)   Context: Matt is blind. He's reporting a conversation he had with
         Foggy Nelson. Foggy said a number of things that Matt found to be
         completely out of character.
         Matt: I was talking to Foggy yesterday. I could see he was very upset.

The fact that $\sqrt{\text{see}}$ entails *vision* with an embedded nominal explains
the infelicity of (139b); a *fact* is an abstract object, and hence cannot be
in the visual field. I account for the polysemy of *see* via the interpreta-
tion rules in (141). I claim that the *inferring* sense of $\sqrt{\text{see}}$ is the else-
where case, whereas *see* is understood in the *visual* sense specifically in
the context of the argument introducing head F_{int}.

(141)   a. $[\![\sqrt{\text{see}}]\!] \leftrightarrow \lambda w . \lambda s . \text{inferring}_w(s)$

         b. $[\![\sqrt{\text{see}}]\!] \leftrightarrow \lambda w . \lambda s . \text{seeing}_w(s) \,/\, F_{\text{int}} \underline{\quad}$

Note that this requires us to revise the structures we have been assum-
ing slightly. Previously, I assumed, following Lohndal (2014), a structure
as in (142), where the categorizer merges prior to the argument introduc-
ing head. I'd like to suggest rather that F_{int} merges prior to the categorizer,
as in (143).[17] This has a number of advantages. It is typically assumed in
the DM literature that contextual allosemy, like contextual allomorphy,
is subject to strict locality. On this view we can unproblematically posit
contextual allosemy rules that render the interpretation of the root sen-
sitive to the presence/absence of a nominal argument.[18]

---

17 Thanks for Giorgos Markopoulous for helping to clarify my thinking on this point.

18 The structures I posit here are similar to those argued for by Harley (2014), who claims
   that roots take complements, which are merged prior to a categorizer. I believe that
   the structures I posit here inherit many of the advantages of Harley without certain
   theoretical disadvantages. For example, Harley is wedded to the idea that roots *project*
   when they merge with a phrasal complement, which is problematic given that roots are
   standardly taken to have no syntactic properties.

(142)

F_{int}

DP F_{int}

… F_{int} v

v $\sqrt{…}$

(143)

v

v F_{int}

DP F_{int}
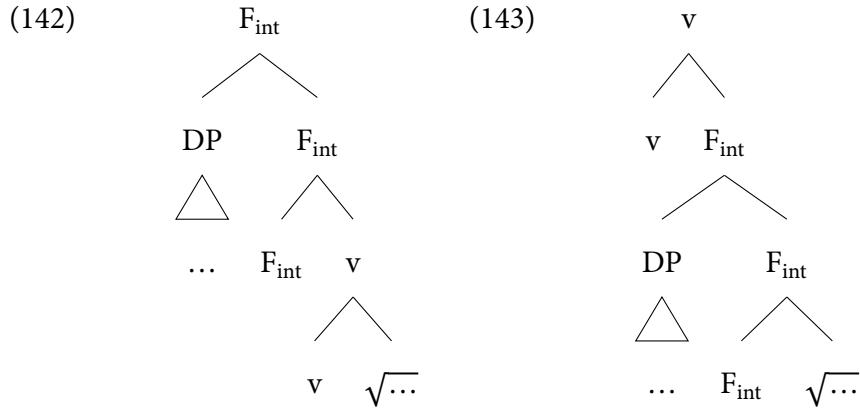
… F_{int} $\sqrt{…}$

Furthermore, we can posit contextual allosemy rules that render the interpretation of F_{int} sensitive to the interpretation of the root. This allows us to account for the Kratzer/Marantz generalization while maintaining the idea that the internal argument is severed. Consider e.g., Kratzer's example of $\sqrt{pick}$. The examples in (144) show clearly that the interpretation of $\sqrt{pick}$ is sensitive to the interpretation of the internal argument.

(144) a. Shirley picked a flower.

   b. Shirley picked a team-mate.

We can account for such sensitivity via contextual allosemy rules of the following kind.

(145) $[\![pick]\!] \leftrightarrow \lambda w . \lambda e . \text{plucking}_w(e)$

   $/ [\text{DP} [F_{int} \underline{\quad}]]$ $\text{plant}_w([\![DP]\!]) = 1$

One could of course object that the allosemy rule in (145) is *not* strictly local, since F_{int} intervenes between the internal argument and the root. However, I assume that contextual allosemy is subject to the same locality conditions as contextual allomorphy, and Jonathan David Bobaljik (2012) shows that it must be necessary for contextual allomorphy rules to be able to 'see past' an intervening head.

furthermore that exponence is cyclic, and categorizers demarcate the cycle.

Furthermore, if a nominal and a *that*-clause are coordinated under $\sqrt{\text{see}}$, the result is infelicitous.

(146)   # Shirley saw [$_{DP}$ Jeff] and [$_{CP}$ that he was upset].

Compare with a coordinated nominal and *that*-clause under $\sqrt{\text{believe}}$, which is not polysemous in the same sense as $\sqrt{\text{see}}$.

(147)   Shirley believes [$_{CP}$ that Jeff is a fraud], and $\sqrt{}$[DP]the rumour that he is sleeping with Annie.

(148)   I can see now that Jeff is upset,
         and I think that Shirley can see the same thing.

2.6.1   *PROPDPs and nominalisations*

Note that if prepositions were simply semantically vacuous, we would expect (149 to be acceptable on the reading where *the same thing* receives an *explanans* reading.

(149)   Somehow, I was convinced by Nathan's explanation that Naomi was late, but unconvinced by Josie's explanation of the same thing.

2.7   THE SEMANTICS OF PROPOSITIONAL DPS

One thing we still haven't reconciled is how PROPDPs such as *something* and the *the same thing* fit into the picture we have been painting thus far. I'd like to suggest that PROPDPs are *special* because they can be anaphoric on/refer to/quantify over higher-order semantic objects. In this section I spell out exactly what this means.

As we have seen, PropDPs such as *something* may compose with clause-taking roots such as *explain*. Despite the fact that PropDPs are syntactically nominal, they pattern with *that*-clauses with respect to their interpretation. PropDPs may also quite generally compose with those verbs which assign case, but do not generally compose with ContDPs. This is illustrated below for the clause-taking roots *promise* and *complain*.

(150) a. Sam promised something.

  b. *Sam promised the possibility that he would give an extra lecture.

  c. Sam promised that he would give an extra lecture.

  d. It was promised that Sam would give an extra lecture.

(151) a. *Hans complained something.

  b. *Hans complained the possibility that he had extra marking.

  c. Hans complained that he had extra marking.

  d. *It was complained that Hans had extra marking.

The solution that I'd like to suggest to this problem is that clause-taking roots which tolerate PropDPs but not ContDPs is that ContDPs denote/quantify over/are anaphoric on members of D_e. This is for the simple reason that (categorised) roots such as $\sqrt{\text{fact}}$ and $\sqrt{\text{story}}$ are predicates of contentful entities.[19]

---

19 I assume here and throughout that categorizers such as n and v are semantically vacuous, but act as the conditioning factor for contextual allosemy rules, consider e.g. $\sqrt{\text{card}}$ in the following environments. When $\sqrt{\text{card}}$ merges with a nominaliser, it is interpreted as a predicate of concrete card entities. When $\sqrt{\text{card}}$ merges with a verbaliser, it is interpreted as a predicate of carding events, the *agent* of which asks to see the *patient*'s ID card. Recall that I assume that events and concrete individuals are both members of D_e. I have used the variable name *e* as shorthand for a function that is only defined for members of D_e that are *events*.

(152) a. I forgot to buy you a present, but I do have a [$_n \sqrt{\text{card}}$].

  b. The bouncer [$_v \sqrt{\text{card}}$]-ed me.

(154)   a. $[\![\sqrt{\text{fact}}]\!] = \lambda w \,.\, \lambda x_\text{e} \,.\, \text{fact}_w(x)$

     b. $[\![\sqrt{\text{story}}]\!] = \lambda w \,.\, \lambda x_\text{e} \,.\, \text{story}_w(x)$

As a matter of their typing, then, CONTDPs will come to denote/quantify over/be anaphoric on contentful entities, and this means they cannot compose directly with a verbalised root, at least not without leading to a type-mismatch further down the line. Rather, CONTDPs must be integrated via an argument introducing head such as F_{int} or F_{ext}.[20]

Moving on to PROPDPs, I repeat the inventory of expressions which exhibit this behaviour in (155).

(155)   PROPDPs

     a.   DPs headed by the noun *thing*, e.g., *the same thing, a different thing, most things, two things, something, everything,* etc.

     b.   The simplex *wh*-expression *what*.

     c.   Anaphoric expressions such as *it* and *that*   See Asher 1993.

     d.   Null operators in comparatives   See Kennedy & Merchant 2000.

I will begin by concentrating on the complex PROPDPs in (155a). One thing that all of these expressions have in common is that they contain the nominalised root $\sqrt{\text{thing}}$. I claim that $\sqrt{\text{thing}}$ has a polymorphic type - that is to say that $[\![\sqrt{\text{thing}}]\!] :: \sigma$, where $\sigma \in \text{type}_\text{B}$ and $\sigma \neq \text{t}$.[21]

---

(153)   a. $[\![\sqrt{\text{card}}]\!] = \lambda w \,.\, \lambda x \,.\, \text{card}_w(x)$

     b. $[\![\sqrt{\text{card}}]\!] = \lambda w \,.\, \lambda e \,.\, \text{carding}_w(e)$

20 Very probably, this doesn't exhaust the inventory of argument introducing heads. See, e. g., Pylkkänen (2008), who argues that applicatives are severed and introduced by a distinct functional head.

21 $\text{type}_\text{B} \subset \text{type}$ is a name for the set of *boolean types*. Concretely, those types σ, where D_σ corresponds to a boolean algebra. I formalize this notion in the next chapter, but for our purposes here it is enough to grasp the intuitive notion that the type of $[\![\sqrt{\text{thing}}]\!]$ ends in t.

The immediate payoff is that composition of a DP built up from $\sqrt{\text{thing}}$ and a verbalised root is well-typed, either with or without meditation via an argument-introducing head. Below I give two LFs for *Sam promised something* which are both well-typed.[22]

(156) Sam promised something.

$\langle s, t \rangle$

λw t

$\langle et, t \rangle$ $\langle e, t \rangle$

DP

something λx t

$\langle et, t \rangle$ $\langle e, t \rangle$

$\mathcal{E}$

e $\langle e, et \rangle$

DP

Sam $\langle et, \langle e, et \rangle \rangle$ $\langle e, t \rangle$

F_{ext}

e $\langle e, et \rangle$

t_x

$\langle et, \langle e, et \rangle \rangle$ $\langle e, t \rangle$

F_{int} $[\, v\, \sqrt{\text{promise}}\,]$
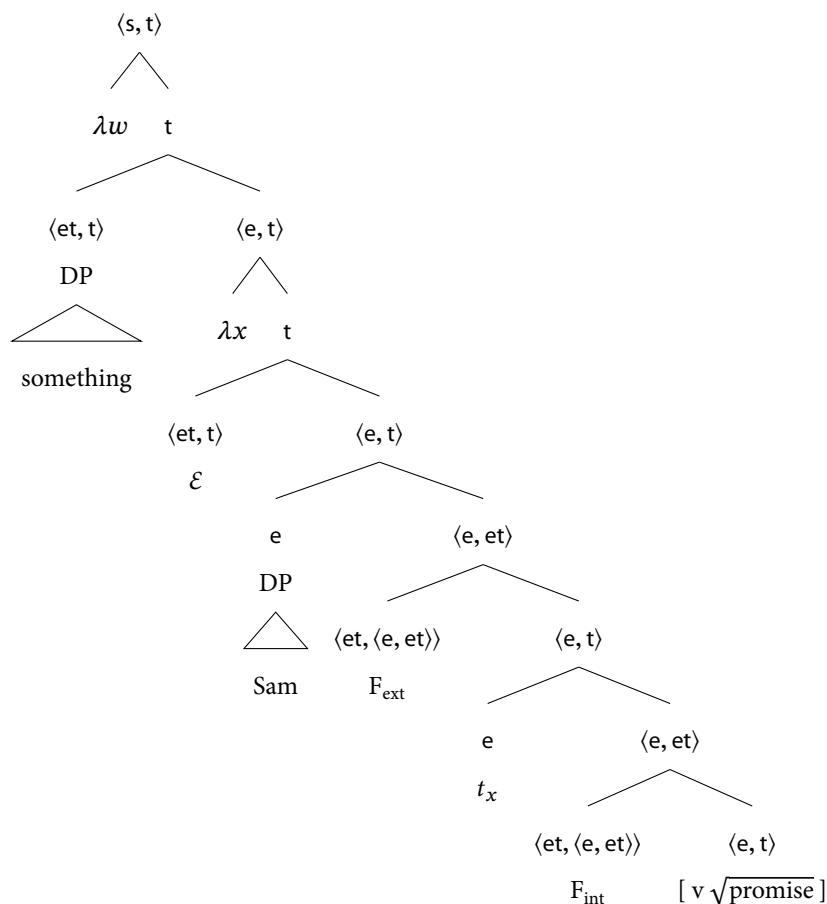
(157) $\lambda w \, . \, \exists x, e \begin{bmatrix} \mathcal{AG}_w(e) = \mathsf{Sam} \\ \mathcal{TH}_w(e) = x \\ \mathsf{promising}_w(e) \end{bmatrix}$

---

22 I use the term "well-typed" to mean that at know point in the semantic composition is there a type mismatch.

Note that we can posit a contextual allosemy rule to account for the interpretation that internal arguments receive with intensional transitive verbs such as *promise*.

(158) $[\![F_{int}]\!]^g = \lambda f . \lambda Q . \lambda e . \mathcal{CONT}_w(e) = \lambda w' . Q(g(\langle 1, \langle e, t \rangle \rangle))$

In a neutral context g just assigns $\langle 1, \langle e, t \rangle \rangle$ to D_e.[23]

(159) Sam promised Patrick two parties

(160) $\lambda w . \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Sam} \\ \mathcal{RECIP}_w(e) = \text{Patrick} \\ \mathcal{CONT}_w(e) = \lambda w' . \exists X[\text{twoParties}_{w'}(X)] \end{bmatrix}$

The other possible LF that type-checks:

---

23 Note that we need to say something about how the world pronoun of $\sqrt{\text{party}}$ comes to be bound by the $\lambda w'$ operator introduced by F_{int}. There are a number of options, including bringing assignment functions into the model and accounting for de-dicto readings with transitive intensional verbs as a kind of binding reconstruction; see Sternefeld 2001, Charlow 2014. It will take us too far afield to show in detail how to integrate existing semantic accounts of binding reconstruction with the framework assumed here.

(161)

$$\langle s, t \rangle$$

$\lambda w \quad t$

$\langle\langle et, t \rangle, t \rangle$ $\langle et, t \rangle$

something

$\lambda P \quad t$

$\langle et, t \rangle$ $\langle e, t \rangle$

$\mathcal{E}$

e $\langle e, et \rangle$

Sam

$\langle et, \langle e, et \rangle \rangle$ $\langle e, t \rangle$

F_{ext}

$\langle e, t \rangle$ $\langle e, t \rangle$

t_P $[\, v \sqrt{\text{promise}}\,]$
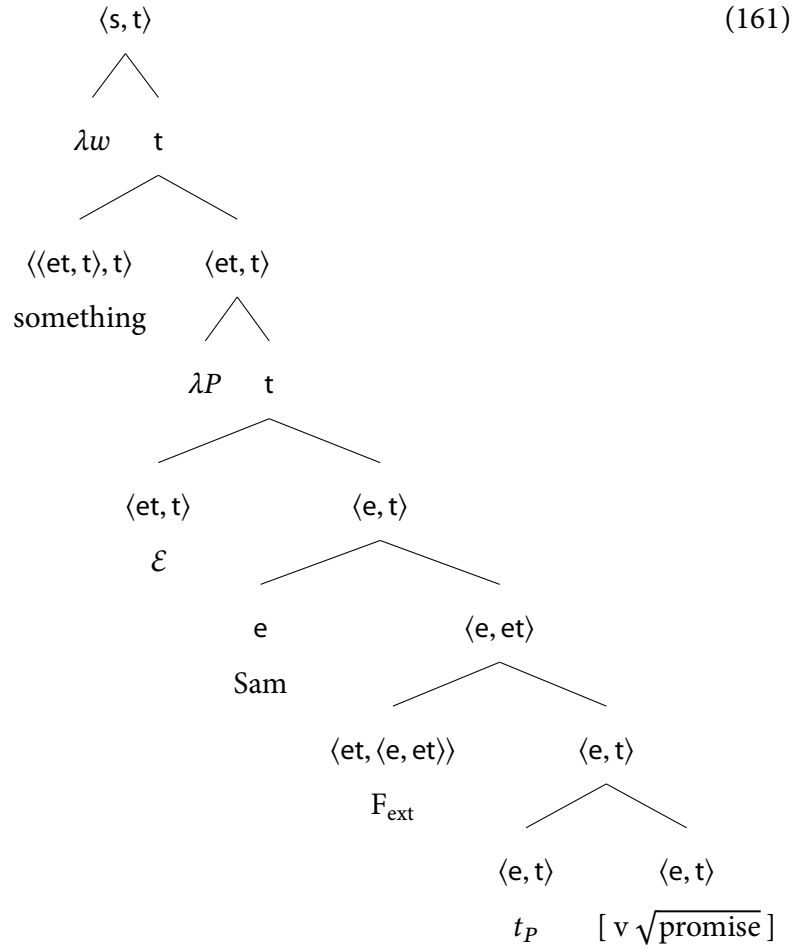
What is the domain of quantification here? if is just $D_{\langle e,t \rangle}$ we end up with extremely weak truth-conditions. (163) just ends up saying saying that there is some property P which holds of Sam's promising event.[24]

$$(163) \quad \lambda w \, . \, \exists P_{\langle e,t \rangle}, e_{e} \begin{bmatrix} \mathcal{AG}_w(e) = \text{Sam} \\ \wedge \text{ promising}_w(e) \\ \wedge P(e) \end{bmatrix}$$

---

24 This is so weak that it will always end up being trivially satisfiable, on the assumption that every entity is self-identical, every entity has at least one property:

$$(162) \quad \lambda x \, . \, x = x$$

We can restrict the domain of quantification in the following way. A predicate P is a candidate *that*-clause denotation if the following holds. It says that every individual of which the P holds has the same content. It essentially ensures that P is semantically the property of having a certain content.

$$(164) \quad \forall w \forall x \forall y \begin{bmatrix} P(x) \wedge P(y) \\ \rightarrow CONT_w(x), CONT_w(y) \text{ is defined} \\ \wedge CONT_w(x) = CONT_w(y) \end{bmatrix}$$

This somewhat more complex semantics is necessary in order to account for examples such as (165).

(165) context: Robert and Georgy are talking about the rules of chess.

    a.   Robert explained that there are sixteen pieces each, that the goal is to checkmate, and that each player has one queen. Georgy (only) explained that there are sixteen pieces each.

    b.   Georgy explained most things that Robert did.

2.7.0.1 *Composition with deadjectival nominals*

One apparent issue for the proposal outlined here involves the contrasts in 166, noticed by Stowell 1981: §7.

(166) a.   I was surprised by Josie's awareness that Nathan was upset.

    b.   *Josie's awareness was that Nathan was upset.

Proposal:

(167)

```
                              ⟨e, t⟩
                          ╱          ╲
                    -ness              ⟨e, t⟩
                      n             ╱         ╲
                              ⟨e, t⟩            ⟨e, t⟩
                                v            ╱       ╲
                             ╱     ╲        𝒞      ⟨s, t⟩
                            v    √aware          ╱    ╲
                                            that Nathan was upset
```

(168) $[\![\text{-ness}]\!] = \lambda P_{\langle e,t \rangle} . \lambda x_e . \text{QUALITY}(x) \wedge Q(x) = P$

The idea is that the suffix *ness* composes with a property *P* and delivers a predicate of qualities, which are mapped to the property that they are the quality of by the function *Q*. I take it that $[_v \text{ v } \sqrt{\text{aware}}]$ denotes a predicate of mental states.

(169) $[\![[_v \text{ v } \sqrt{\text{aware}}]]\!] = \lambda w . \lambda s . \text{STATE}_w(s) \wedge \text{awareness}_w(s)$

Mental states are things for which $\mathcal{CONT}$ is defined, but $\mathcal{CONT}$ is not defined for qualities. Note that this observation extends to morphologically simplex emotive predicates.

2.8   MEANINGFUL COMPLEMENTIZERS?

We might ask, at this stage, whether it makes sense to identify $\mathcal{C}$ with the complementizer *that*. Recall that $\mathcal{C}$ is responsible for shifting a Stalnakerian proposition to a predicate.

(170) $[\![\mathcal{C}]\!] = \lambda w . \lambda p . \lambda x . \mathcal{CONT}_w(x) = p$

Consider the following:

(171)   Abed said [$_{CP_1}$ that Shirley is upset] and [$_{CP_2}$ that Britta left].

If (171) involves CP coördination and *that* = $\mathcal{C}$, then we wrongly predict (171) to be infelicitous. To see why, consider the following LF.

(172)
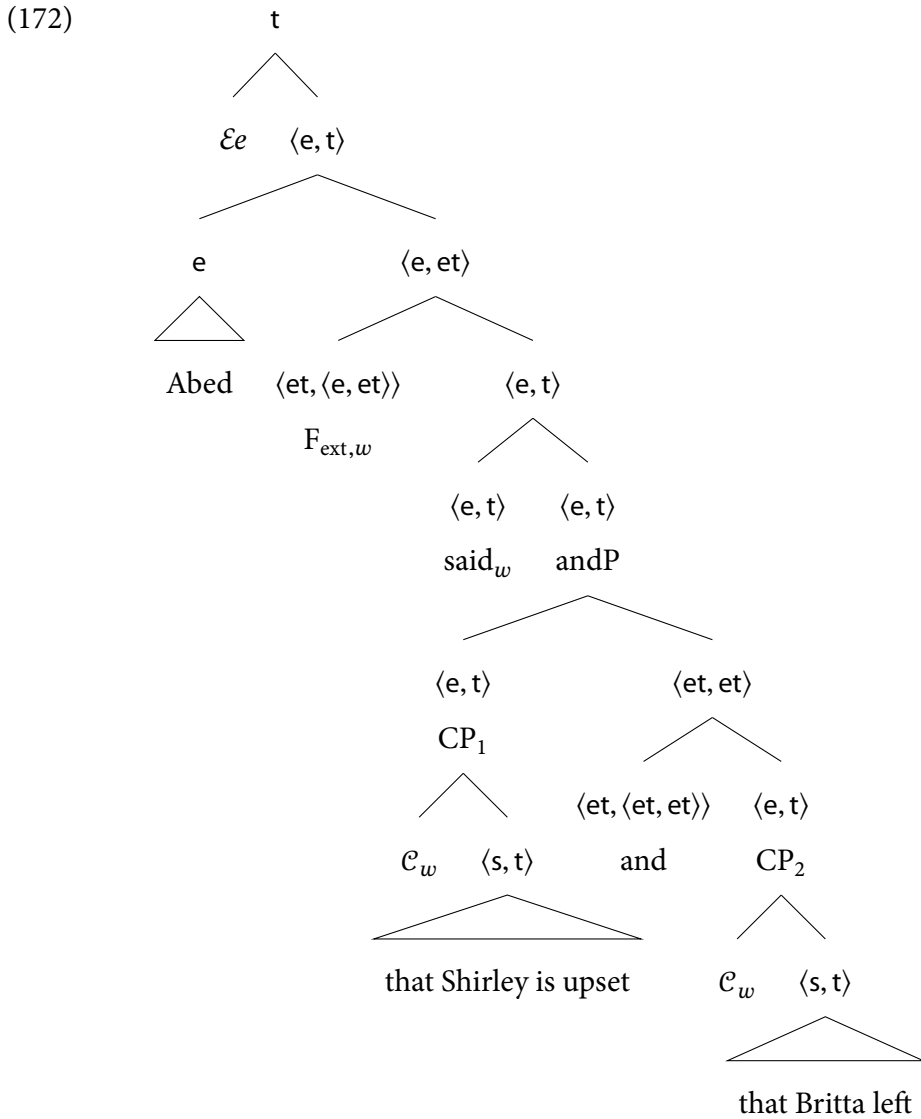
I assume that *and* denotes the polymorphic Boolean operator $\sqcap$, defined below (see Partee & Rooth 2012, Winter 2001) for any boolean type τ.[25]

$$(173) \quad \sqcap_{\langle\tau,\langle\tau,\tau\rangle\rangle} = \begin{cases} \wedge_{\langle t,\langle t,t\rangle\rangle} & \tau = t \\ \lambda X_\tau \,.\, \lambda Y_\tau \,.\, \lambda Z_{\sigma_1} \,.\, X(Z) & \tau = \langle\sigma_1,\sigma_2\rangle \\ \qquad\qquad \sqcap_{\langle\sigma_2,\langle\sigma_2,\sigma_2\rangle\rangle} Y(Z) \end{cases}$$

Once we compute the meaning of (172), the result is the following:

(174) a. $[\![\text{CP}_1]\!] = \lambda x \,.\, \mathcal{CONT}_w(x) = \text{Shirley is upset}$

     b. $[\![\text{CP}_2]\!] = \lambda x \,.\, \mathcal{CONT}_w(x) = \text{Britta left}$

     c. $[\![\text{andP}]\!]$

         $= \sqcap([\![\text{CP}_2]\!])([\![\text{CP}_1]\!])$

         $= \lambda x \,.\, \mathcal{CONT}_w(x) = \text{Shirley is upset}$

            $\wedge \mathcal{CONT}_w(x) = \text{Britta left}$

     d. $[\![\text{said}_w]\!] = \lambda e \,.\, \text{saying}_w(e)$

     e. $\text{PM}([\![\text{said}_w]\!])([\![\text{andP}]\!])$

         $= \lambda e \,.\, \text{saying}_w(e)$

            $\wedge \mathcal{CONT}_w(e) = \text{Shirley is upset}$

            $\wedge \mathcal{CONT}_w(e) = \text{Britta left}$

     f. $[\![\text{F}_{\text{ext}}]\!] \leftrightarrow \lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{AG}_w(e) = x \wedge f(e) \,/ \underline{\quad} \,[_\text{v} \text{v} \sqrt{\text{say}}\,]$

     g. ...

     h. 1 iff $\exists e$ $\begin{bmatrix} \mathcal{AG}_w(e) = \text{Abed} \\ \wedge \text{ saying}_w(e) \\ \wedge \mathcal{CONT}_w(e) = \text{Shirley is upset} \\ \wedge \mathcal{CONT}_w(e) = \text{Britta left} \end{bmatrix}$

---

25 See ch. 4 for more details.

In no world of evaluation can there be an individual e, the content of which is Shirley is upset, and the content of which is Britta left. This is because Shirley is upset and Britta left are distinct propositions (i.e. distinct characteristic functions of sets of possible worlds, according to the notion of content we have been assuming thus far). In any given world w, $CONT_w$ is a partial function, the domain of which is the set of contentful individuals. Each contentful individual is mapped to a unique content, so the conjuncts in (174h) are never jointly satisfiable.

On the basis of evidence from complementizers and conjunction, I assume that C is a distinct functional head in a selectional relationship with CP. The LF for (171) is as in (175). I assume that C is semantically vacuous and simply denotes the identify function of type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$.

(175)

```
                              …
                            /   \
                         …       ⟨e, t⟩
                                  𝒞P
                                /    \
                          ⟨st, et⟩    ⟨s, t⟩
                             𝒞_w       andP
                                     /      \
                                ⟨s, t⟩       ⟨st, st⟩
                                 CP₁          and′
                               /    \        /      \
                         ⟨st, st⟩  ⟨s, t⟩  ⟨st, ⟨st, st⟩⟩  ⟨s, t⟩
                           C₁      TP₁       and          CP₂
                                 /_____\                /    \
                             Shirley is upset      ⟨st, st⟩    ⟨s, t⟩
                                                     C₂        TP₂
                                                            /_____\
                                                           Britta left
```
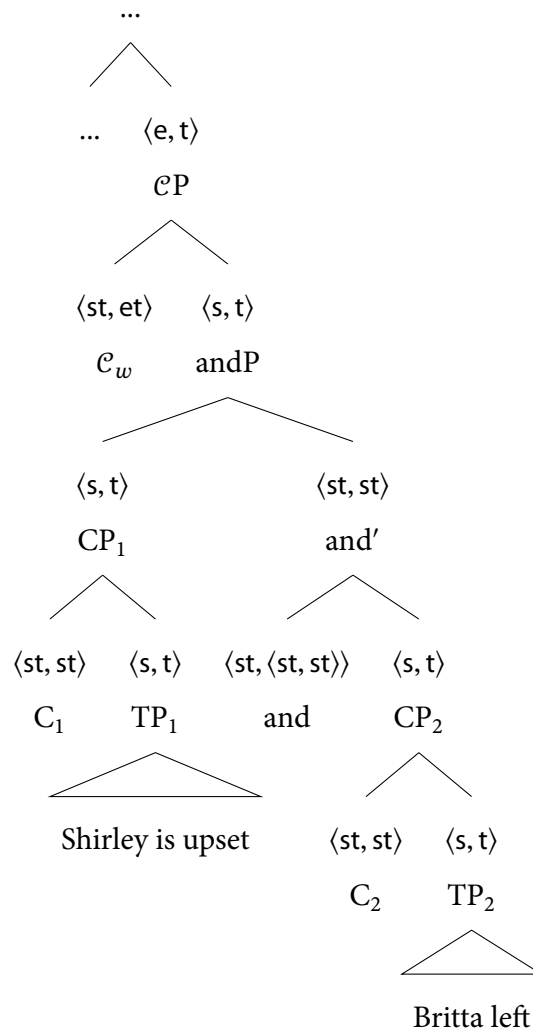
One possible argument against this line of reasoning is the possibility of Conjunction Reduction (CR). See, e.g., Hirsch 2016, 2017, who argues against analysing conjunction as a polymorphic Boolean operator ⊓, and in favour of the rigidly-typed denotation in (176).

(176) $[\![\text{and}]\!] = \lambda t \in D_t . \lambda u \in D_t . t \wedge u$

A consequence of this conjecture is that conjunction is always sentential – any apparent non-sentential conjunction involves CR. The LF of

(171) according to this conjecture would be as in (177), with two distinct $\mathcal{E}$ operations, one in each conjunct.[26]

(177)   Abed [$_{vP}$ t_A said [$_{CP_1}$ that Shirley is upset]]
         and [$_{vP}$ t_A ~~said~~ [$_{CP_2}$ that Britta left]].

The predicted truth-conditions would be as in (178).

(178)   1 iff $\exists e, e'$ $\begin{bmatrix} \mathcal{AG}_w(e) = \text{Abed} \\ \wedge\, \mathcal{AG}_w(e') = \text{Abed} \\ \wedge\, \text{saying}_w(e) \\ \wedge\, \text{saying}_w(e') \\ \wedge\, \mathcal{CONT}_w(e) = \text{Shirley is upset} \\ \wedge\, \mathcal{CONT}_w(e) = \text{Britta left} \end{bmatrix}$

Adopting a CR analysis of such examples would allow one to maintain that $\mathcal{C}$ *is* the complementizer *that*. Here I offer two brief arguments against the conjecture that CP-conjunction always involves CR.

2.8.0.1   *Collective predication*

Putative examples of predicates that are collective on their internal arguments are *to rattle off* and *to list*.

(179)   a.   John {rattled off | listed} that Shirley is invited and that Britta is invited.

         b.   # John {rattled off | listed} that Shirley is invited.

The fact that (179b) is infelicitous suggests that CP coordination in such cases cannot receive a CR analysis, as in (180).

---

26 Hirsch 2016, 2017 avoids the pitfalls of the traditional conception of CR by adopting the vP-internal subject hypothesis, and treating conjunction as syntactically conjoining vPs, which are semantically of type t.

(180)   John {rattled off | listed} that Shirley is invited

and ~~John {rattled off | listed}~~ that Britta is invited

As acknowledged by Hirsch collective predication cannot be easily accounted for via CR (although Hirsch 2017 does offer some speculative remarks on how to do so, based on an extension of Winter 2001 and Champollion 2016).

2.8.0.2   *Non-monotonic attitude verbs*

Another argument against CR is CP-coordination under non-monotonic attitude verbs, such as emotive verbs.

(181)   a.   Jeff is annoyed that Shirley is upset and that Britta is upset.

b.   Jeff is annoyed that Shirley is upset.

The LF that Hirsch's CR account predicts for (181a) is given in (182).

(182)   Jeff $[_{vP_1} t_J$ is annoyed $[_{CP_1}$ that Shirley is upset $]$ $]$

and $[_{vP_2} t_J$ ~~is annoyed~~ $[_{CP_2}$ that Britta is upset $]$ $]$

This LF would of course guarantee that the inference from (181a) to (181b) should go through. There must therefore be a non-CR representation o (181a) in order to capture the reading where (181b) is not necessarily entailed.

2.9   CONSTRAINING THE SYSTEM

On the neo-Davidsonian view outlined here, embedded *that*-clauses are semantically modifiers. One question that immediately arises is why embedded *that*-clauses cannot be stacked, like other modifiers, i. e., why is (183) unacceptable?

(183)   # Abed believes [$_{CP}$ that Jeff is old] [$_{CP}$ that Shirley is upset].

To consider why this should be, it is useful to consider what constrains stacking of thematic arguments in a neo-Davidsonian system. Consider the Logical Form in (184). (184) expresses a contradiction. This is because thematic roles are *functions* from a world and an eventuality to an individual (Parsons 1990, Champollion 2017).[27] This guarantees that thematic roles map each world-eventuality pair to a *unique* individual. Consequently, a given *hitting* event has a unique $\mathcal{TH}()$.

(184)   a. *Shirley hit [$_{DP}$ Jeff] [$_{DP}$ Troy].

b. $\lambda w . \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Shirley} \\ \wedge\ \mathcal{TH}_w(e) = \text{Jeff} \\ \wedge\ \mathcal{TH}_w(e) = \text{Troy} \\ \wedge\ \text{hitting}_w(e) \end{bmatrix}$

As pointed out in Moulton (2009), this kind of explanation can be extended in order to rule out stacking of embedded *that*-clauses. (183) has the Logical Form in (186).[28]

(186) $\lambda w . \exists s \begin{bmatrix} \mathcal{HOLDER}_w(\text{Shirley}) = a \\ \wedge\ \mathcal{CONT}_w(s) = \lambda w' . \text{Jeff is old in} w' \\ \wedge\ \mathcal{CONT}_w(s) = \lambda w'' . \text{Shirley is upset in } w'' \end{bmatrix}$

---

27 The conjecture that eventualities have a unique *agent, theme* and so on is referred to in the literature at the Unique Role Requirement (URR) (see, e. g., Carlson 1984). The conjecture that thematic roles are functions of course directly captures this.

28 This approach to ruling out stacking of thematic arguments, and by extension stacking of *that*-clauses, comes with a family of problems. The straightforward prediction is that co-referential names can be expressed as multiple thematic arguments of a predicate. This however isn't possible, as illustrated by the unacceptability of (185) (in a context where the speaker considers "Clark Kent" and "Superman" to denote the same individual).

(185) *Lois loves [$_{DP}$ Clark Kent] [$_{DP}$ Superman].

This is however plausibly a matter for the grammar. Theories of DP licensing (i. e. case theory) independently predict (185) to be unacceptable since [$_{DP}$ Superman] doesn't receive structural case.

(186) is contradictory in the same way as (184); the functionhood of *CONT* guarantees that stacked *that*-clauses give rise to a contradiction.

There is a problem with this explanation however. If two propositions happen to pick out the same set of possible worlds, then they should be possible. This is not the case, as illustrated in

(187) a. *Hank believes [$_{CP}$ that it's raining and not raining]
           [$_{CP}$ that it's Monday and Tuesday].

       b. Hank believes that it's raining and not raining.

       c. Hank believes that it's Monday and Tuesday.

According to a classical conception of propositions as denoting sets of possible worlds, contradictions denote the empty set, since there is no world w in which a contradiction is true. The logical form we predict for (187a) is therefore non-contradictory, as shown in (188). Note that the acceptability of (187b) and (187c) render an explanation in terms of pragmatic oddness implausible.

$$(188) \quad \lambda w \,.\, \exists s \begin{bmatrix} \mathcal{HOLDER}_w(s) = \mathsf{Hank} \\ \wedge\ \mathsf{belief}_w(s) \\ \wedge\ \mathcal{CONT}_w(s) = \varnothing \\ \wedge\ \mathcal{CONT}_w(s) = \varnothing \end{bmatrix}$$

This poor prediction however belies a deeper problem with the classical conception of propositions as sets of possible worlds. Consider (189) in a contex where Zach believes that it's raining and not raining, and Jenna believes that it's Monday and Tuesday.

(189) # Zach and Jenna believe the same thing.

The fact that (189) is clearly infelicitous suggests that the classical conception of propositions as sets of propositions is not sufficiently fine-grained to account for our intuititions concerning proposition individu-

ation. These kinds of problems with the classical conception of propositions are well-known in the philosophy of language literature, and have in part motivated a variety of alternative accounts of sentence meaning which allow for finer-grained individuation (see, e. g., Yablo 2014 for an overview).

The account of clausal embedding I argue for here is largely independent of the kind of semantic object we identify as the *content* of an individual in a world of evaluation. I have chosen to use the classical conception of a proposition as a set of possible worlds largely to simplify the compositional apparatus, and to integrate the system argued for here more closely with extant work on the syntax-semantics interface.

Since we independently need a finer-grained notion of *proposition* to account for the infelicity of (189), I assume that whatever turns out to be the correct notion of proposition will also rule out stacking of propositions which happen to have the same intension, such as contradictions, tautologies, and mathematical truths, on the classical view.

2.10 A NOTE ON THE SEMANTICS OF CONTENT NOUNS

King (2002) assumes, without much discussion, that descriptions of the form *the proposition that P* denote propositions, much like *that*-clauses. In the current setting that means that both *the proposition that P* and *that P* are taken to denote functions from possible worlds to truth values of type $\langle s, t \rangle$. King (2002) central evidence for this position is that both *the proposition that P* and *that P* can be predicated of predicates of veracity, i. e., *true* and *false*, as in (190). We can flesh out King's assumptions in the current setting by assigning predicates of veracity denotations of the following sort:[29]

(190)   The proposition that FoL is undecidable is true.

---

29 Following the assumptions laid out in chapter 1, recall that predicates take world arguments which come to be bound by an outer λw operator, and that sentences are taken to denote propositions.

(191)   a. $[\![\text{true}]\!] = \lambda w_s \,.\, \lambda p_{\langle s,t\rangle} \,.\, p(w) = 1$

   b. $[\![\text{the proposition that FoL is undecidable}]\!]$

      $= [\![\text{that FoL is undecidable}]\!]$

      $= \lambda w'_s \,.\, \text{that FoL is undecidable in } w'$

(192) $\lambda w \,.\, [[\![\![\text{true}]\!](w)]([\![\text{the proposition that FoL is undecidable}]\!])]$

   $= \lambda w \,.\, \text{FoL is undecidable in } w$

Of course it is easy to capture these same facts in the current setting, on the assumption that a metalanguage function $CONT$ maps abstract objects to their contents in a given world. We can analyse predicates of veracity, such as *true*, as predicates over (contentful) individuals, as in (194a).[30]

(194)   a. $[\![\text{true}]\!] = \lambda w \,.\, \lambda x_e \;:\; CONT_w(x) \text{ is defined}$

      $.\, CONT_w(x)(w) = 1$

   b. $[\![\text{the proposition that FoL is undecidable}]\!]$

      $= \iota x \begin{bmatrix} \text{proposition}_w(x) \\ \wedge\, CONT_w(x) = \lambda w' \,.\, \text{FoL is undecidable in } w' \end{bmatrix}$

(195) $\lambda w \,.\, [[\![\![\text{true}]\!](w)]([\![\text{the proposition that FoL is undecidable}]\!])]$

   $= \lambda w \,.\, CONT_w(\iota x \begin{bmatrix} \text{proposition}_w(x) \\ \wedge\, CONT_w(x) \\ = \lambda w' \,.\, \text{FoL is undecidable in } w' \end{bmatrix})(w)$

      $= 1$

---

30 I assume that predicates of veracity are only defined for individual world pairs $< x, w >$ such that x has propositional content in w.

(193)   a.   #Jason is true.

   b.   #It's not the case that Jason is true.

This aside, it is difficult to give a compositional account of how DPs headed by content nouns could come to denote propositions. For the noun *proposition*, one possibility would be to assume the denotation in (196), i. e. to treat it as an identity function of type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$

(196) $[\![\text{proposition}]\!] = \lambda p_{\langle s,t\rangle} . p$

But then, what does the definite article do? If it has its standard meaning (the *iota* operator), then we predict that a definite DP headed by the noun *proposition* should be of type s – it should denote the unique world in which the proposition p is true. This cannot be correct however.

INTERROGATIVES AS MODIFIERS

IN THIS CHAPTER, I sketch how the theory of *that*-clauses as modifiers argued for here can be extended to embedded interrogatives. In §3.1, I outline a concrete syntax-semantics interface for interrogatives, building on Cable 2010, Charlow 2014, 2017, and Elliott 2019. In §3.2 I introduce Lahiri's (2002) influential typology of question-embedding predicates, laying out the basic empirical ground our account of embedded interrogatives needs to cover, in terms of selectional restrictions. In §3.3, I present arguments that, much like *that*-clauses, embedded interrogatives should be assigned a predicative denotation. In §3.4, I show how we can enrich the notion of *content* we have been assuming thus far to encompass both declarative and interrogative meanings. In §3.5, I show how the problems raised in the previous chapter by *substitution failures* arise for embedded interrogatives too, providing additional motivation for assigning interrogatives a predicative denotation. Finally, in §3.7, I show how the semantics for embedded interrogatives outlined here can capture data deemed problematic for a traditional semantics for responsive predicates.

"It is really quite impossible to be affirmative about anything which one refuses to question; one is doomed to remain inarticulate about about anything which one hasn't, by an act of the imagination, made one's own."

— Notes of a Native Son, James Baldwin

3.1   COMPOSITIONAL BACKGROUND

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There are a number of different theories of question meanings on the market. For expository purposes I adopt a theory according to which interrogatives denote (characteristic functions of) sets of answers. [1] I give

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1 The locus classicus for this view is Hamblin 1973. See also Karttunen 1977 and Heim 1994 for important subsequent developments.

a sample question denotation in (197).[2]. Assuming that the boys in @ are Jeff, Abed, and Troy, the set of propositions denotation by *which boy left?* is that given in (198).

(197) ⟦which boy left?⟧

$$
= \lambda w \,.\, \lambda p_{\langle s,t \rangle} \,.\, \exists x \begin{bmatrix} \mathsf{boy}_w(x) \\ \\ \wedge\, p = \lambda w' \,.\, \exists e \begin{bmatrix} \mathcal{AG}_{w'}(e) = x \\ \\ \wedge\, \mathsf{leaving}_{w'}(e) \end{bmatrix} \end{bmatrix}
$$

(198) ⟦(197)⟧(@) = $\left\{ \begin{array}{l} \lambda w' \,.\, \exists e [\mathcal{AG}_{w'}(e) = \mathsf{Jeff} \wedge \mathsf{leaving}(w)] \\ \lambda w' \,.\, \exists e [\mathcal{AG}_{w'}(e) = \mathsf{Abed} \wedge \mathsf{leaving}(w)] \\ \lambda w' \,.\, \exists e [\mathcal{AG}_{w'}(e) = \mathsf{Troy} \wedge \mathsf{leaving}(w)] \end{array} \right\}$

How are question meanings built via compositional apparatus? I adopt a theory of interrogatives at the syntax-semantics interface argued for in Elliott (2019), building primarily on work by Cresti (1995), Charlow (2017) on alternative semantics.

The idea, in a nutshell, is that question meanings are assembled via two polymorphic operators that work in tandem to allow alternative-denoting things to take scope. I assume that *wh*-phrases such as *which boy* simply denote sets of alternatives.

(199) ⟦which boy$_@$⟧ $= \lambda x \,.\, \mathsf{boy}_@(x)$

This is of course not the only theory of question meanings on the market. See, e. g., Groenendijk & Stokhof 1984 for an account of question meanings as partitions over the set of possible worlds, and Ciardelli, Groenendijk & Roelofsen 2015 for an elaboration of this view within the framework of Inquisitive Semantics.

2 Note that to maintain a parallel with the theory of intensionality I have adopted throughout this work, which does away with *Intensional Function Application* as a special composition rule, I assume that interrogatives have as their extensions objects of type ⟨s, ⟨s, t⟩⟩, i. e., a function from a world of evaluation to a Hamblin/Kartunnen question meaning.

I adopt Cable's (2010) syntax for interrogatives.[3] Cable argues at some length that *wh*-questions never involve movement of *wh*-phrase directly to the left-periphery, but rather movement of a QP. In English, a covert head Q takes a constituent containing a *wh*-element as its complement, and *agrees* with the *wh*-element (Cable argues that *Tlingit* is a language in which Q is overt). C_Q bears an uninterpretable Q feature and has the EPP property. It probes down and agrees with a QP, attracting the QP to its specifier as a reflex of the EPP property. One advantage of Cable's proposal is that it eliminates pied-piping as a primitive operation in the grammar. *wh*-questions always simply involve phrasal movement of a QP. What has been described as *pied-piping* in the literature is simply phrasal movement of a QP, where the relation between Q and the *wh*-expression is non-local.

---

3 Both Cable (2010) and Kotek (2014) provide a well worked-out compositional semantics for the kind of syntactic representation provided here. I believe that both Cable's and Kotek's accounts have some deficiencies compared to the framework proposed here. Both accounts crucially invoke a bidimensional alternative semantics (Rooth 1985), and inherit problematic aspects of this system, such as the difficulty of defining a satisfactory correlate of PA in the alternative-semantic dimension (see Shan 2004, Charlow 2014, 2017 for discussion).

Furthermore, both Cable's and Kotek's proposals fail to give a satisfactory compositional semantics for interrogatives involving *nested wh-expressions*, as illustrated by the example in (200).

(200)   [Which book by [which author]]$_i$ did you read t_i last week?

See Elliott (2019) for detailed discussion of these issues, and further arguments for the compositional system outlined here.

(201)

```
                    CP
                  /    \
               QP        …
              /  \      /  \
             Q   DP₁  C_Q   TP
                 / \       / \
             which boy   …t₁…
```
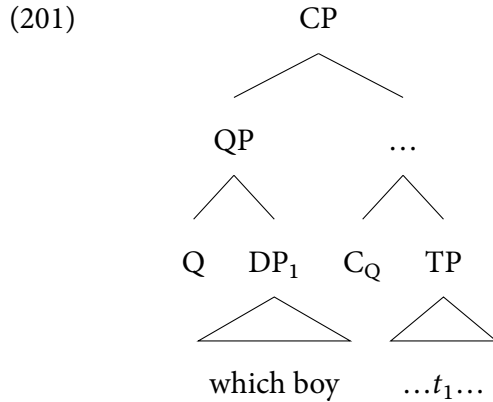
The interrogative complementizer C_Q is interpreted as Partee's (1986) IDENT operator.

(202) For any type σ

$$\llbracket C_Q \rrbracket = \text{IDENT} = \lambda a_\sigma . \lambda b_\sigma . b = a$$

The Q particle has a more complex meaning. What Q does, in informal terms, is take an alternative-denoting argument X, and convert it into a Cresti-style *wh*-expression meaning. The denotation in function talk is given in (203-①), and in set talk in (203-②).

(203) For any types σ_1, σ_2

$$\llbracket Q \rrbracket = \lambda X_{\sigma_1 t} . \lambda f_{\langle \sigma_1, \sigma_2 t \rangle} . \begin{cases} ① \ \lambda b_{\sigma_2} . \exists x_{\sigma_1}[X(x) \wedge f(x)(b)] \\ ② \ \{ b_{\sigma_2} \mid \bigcup_{x \in X} f(x)(b) \} \end{cases}$$

The ingredients come together in the following LF:[4]

---

[4] For simplicity of exposition, I assume here that movement leaves behind a simple variable. Fox (2002), Ulrich Sauerland (1998) and others however have argued that movement necessarily leaves behind a *copy*. The orthodox method for interpreting copies in semantics is via *trace conversion*, which essentially involves converting the lower copy into an indexed definite description. It is possible in principle to combine the approach to *wh*-movement outlined here with a category neutral theory of trace conversion (see, e. g., Moulton 2015, for one formulation).

(204) a. Which boy left?

b.

$$\lambda w \quad \lambda p \,.\, \exists x \begin{bmatrix} \text{boy}_x(x) \\[4pt] \wedge\, p = \lambda w'' \,.\, \exists e \begin{bmatrix} \mathcal{AG}_{w'}(e) \\ = x \\ \wedge\, \text{leaving}_{w'}(e) \end{bmatrix} \end{bmatrix}$$

$$\lambda f \,.\, \lambda p \,.\, \exists x \begin{bmatrix} \text{boy}_w(x) \\ \wedge\, f(x)(p) \end{bmatrix} \quad \lambda x \,.\, \lambda p \,.\, p = \lambda w' \,.\, \exists e \begin{bmatrix} \mathcal{AG}_{w'}(e) \\ = x \\ \wedge\, \text{leaving}_{w'}(e) \end{bmatrix}$$

$$\lambda X \,.\, \lambda f \,.\, \lambda p \,.\, \exists x_{\sigma_1} \begin{bmatrix} X(x) \\ \wedge\, f(x)(p) \end{bmatrix} \quad \lambda x \,.\, \text{boy}_w(x)$$
Q

DP

which boy$_w$

$$\lambda x \quad \lambda p \,.\, p = \lambda w' \,.\, \exists e \begin{bmatrix} \mathcal{AG}_{w'}(e) \\ = x \\ \wedge\, \text{leaving}_{w'}(e) \end{bmatrix}$$

$$\lambda a_\sigma \,.\, \lambda b_\sigma \,.\, b = a \quad \lambda w' \,.\, \exists e \begin{bmatrix} \mathcal{AG}_{w'}(e) \\ = x \\ \wedge\, \text{leaving}_{w'}(e) \end{bmatrix}$$
C_Q

$\lambda w'$ ...

$\mathcal{E}$ ...

x ...

$\text{F}_{\text{ext},w'}$ $\text{left}_{w'}$

There is a lot going on here, so I will include an informal description of how computation proceeds, from the bottom up. In the syntax, the QP containing the *wh*-expression *which boy* undergoes *wh*-movement to specCP, leaving behind a trace in its base position (the specifier of F_{ext}), which is interpreted as a variable ranging over individuals. Composition of the question nucleus proceeds as normal, resulting in an (assignment-dependent) proposition. C_Q then shifts this assignment proposition to a set of propositions, and the lambda operator introduced by movement of the *wh*-expression abstracts over the external argument. In the QP, Q

composes with the *wh*-phrase, and converts it into an expression which scopes into question meanings. The QP composes with its sister via FA, resulting in a standard Hamblin/Karttunen question meaning.

3.2 TYPOLOGY OF QUESTION-EMBEDDING PREDICATES

Before discussing embedded interrogatives further, it will be useful to introduce Lahiri's (2002) influential typology of interrogative-embedding predicates. The tree in (205) is adapted from Lahiri 2002: 286-287 and Spector & Egré 2015: pp. 1734.

(205)

Predicates that take interrogative complements

Rogative
wonder, ask, depend on, investigate …

Responsive

Veridical
know, remember, forget, discover, show,…
tell, communicate, be surprised, amaze,…

Non-veridical
be certain about, agree on, conjecture about,…
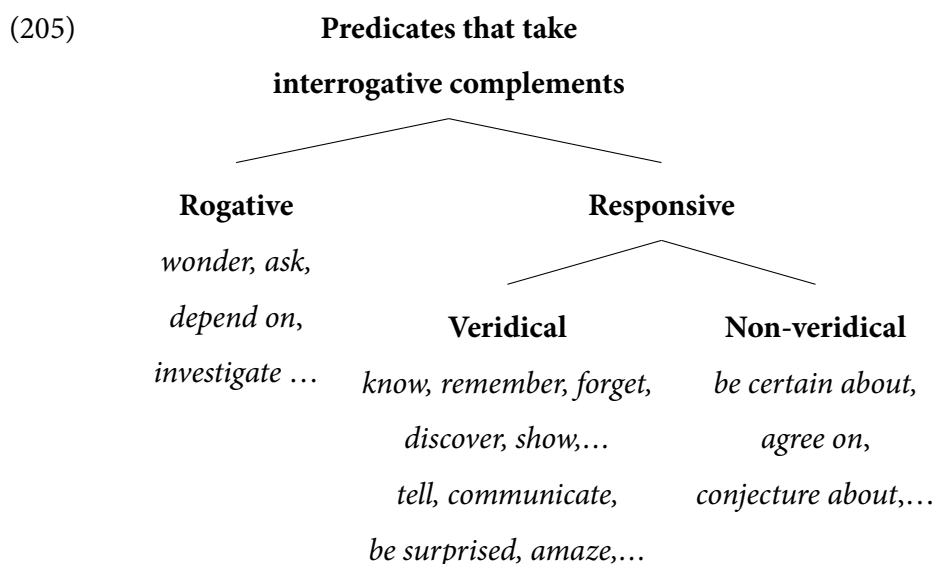
Lahiri proposes a broad distinction between *rogative* predicates on the one hand, and *responsive* predicates on the other. Rogative predicates are those which are compatible with embedded interrogatives but reject embedded declaratives, as illustrated in (206) for √wonder.

(206)   Jeff is wondering $\begin{cases} \text{which of his friends is upset} \\ \text{*that Shirley is upset} \end{cases}$
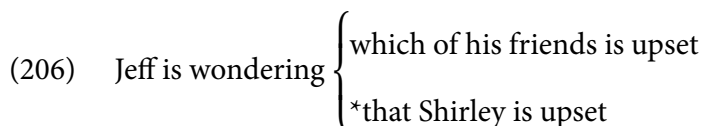
Responsive predicates, on the other hand, are those which are compatible with both embedded interrogatives and embedded declaratives, and which encode semantically a relation between the *attitude holder* and an answer to the question denoted by the embedded interrogative. Consider example $\sqrt{\text{know}}$.

(207)   Jeff knows $\begin{cases} \text{which of his friends is upset} \\ \text{that Shirley is upset} \end{cases}$

Observe that when $\sqrt{\text{know}}$ embeds an interrogative, the appropriate paraphrase is: Jeff stands in the *knowing* relation to the (true) answer to the question *which of Jeff's friends is upset*. Beyond Lahiri's typology, there is also a class of what I shall dub *anti-rogative predicates* such as $\sqrt{\text{belief}}$ and $\sqrt{\text{promise}}$ (see, e. g. Uegaki 2015b for discussion).

We can show that these selectional properties persist in the nominal domain, for those predicates which have nominal forms. (208) and (209) illustrate the persistence of interrogative-rejection with anti-rogative predicates in the verbal and nominal domain. (210) illustrates the persistence of declarative-rejection with rogative predicates in the verbal and nominal domain. (211) illustrates the persistence of responsivity across nominal and verbal domains.

(208)   a.   Henning believes [that Nathan will be well-behaved].

   b.   *Henning believes [who will be well-behaved].

   c.   Henning's belief [that Nathan will be well-behaved].

   d.   *Henning's belief (of) [who will be well-behaved].

(209)   a.   Henning promises [that Nathan will be well-behaved].

   b.   *Henning promises [who will be well-behaved].

   c.   Henning's promise [that Nathan will be well-behaved].

   d.   *Henning's promise (of) [who will be well-behaved].

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(210) a. *Humphrey is investigating [that Lauren is guilty].

     b. Humphrey is investigating [which suspect is guilty].

     c. *Humphrey's investigation [that Lauren is guilty].

     d. Humphrey's investigation into [which suspect is guilty]

(211) a. Humphrey discovered [that Lauren is guilty].

     b. Humphrey discovered [which suspect is guilty].

     c. Humphrey's discovery [that Lauren is guilty].

     d. Humphrey's discovery of [who is guilty].

3.3 EMBEDDED INTERROGATIVES AS MODIFIERS

Is there any compelling reason to assign embedded interrogatives a predicative denotation? One suggestive piece of evidence is that, much like embedded declaratives, embedded interrogatives may compose directly with nominals.

(212) The issue of [who is guilty].

Note that, unlike what we observe with embedded declaratives, when an embedded interrogative composes directly with a nominal, a prepositional element *of* must obligatorily be present. When a declarative composes with a nominal, a prepositional element may not be present.[5]

---

5 It might seem like there is an easy solution to this issue: one could simply claim that, unlike embedded declaratives, embedded interrogatives are in fact syntactically nominal, and require case. The prepositional element *of* is simply a semantically vacuous case-assigner. This isn't going to work however, as there are other environments in which embedded interrogatives and nominals display differing behaviour with respect to licensing (the examples in (213) are from D. Pesetsky 2014).

(213) a. Bill was curious [when John was leaving for Syracuse]

     b. It is unclear [how to get to syracuse by car]

(215) *The claim of [that Lauren is guilty].

I assume that this reflects a difference between embedded interrogatives and declaratives in terms of their syntactic licensing conditions. This is borne out by the fact that, unlike *that*-clauses, interrogatives are not subject to the *[P CP] constraint, as illustrated by the contrast below.

(216) a. *Nathan thought about that he should stop drinking.

b. Nathan thought about whether he should stop drinking.

One argument in favour of treating interrogatives in a parallel fashion to declaratives - and therefore as predicates - is that, like *that*-clauses and relative clauses, but unlike true arguments, interrogatives with nominals obviate condition C violations. The pair of examples in (217) (from Moulton 2017: pp. 294) illustrates the baseline contrast between a relative clause modifier (217a) and a true argument (217b) with respect to condition C obviation; when the co-referential R-expression is contained within a relative clause modifier the condition C violation is obviated, whereas when the co-referential R-expression is contained with an argument, condition C is violated. The examples in (218) show that *that*-clauses pattern with relative clause modifiers; when the R-expression is contained in a *that-clause*, the condition C violation is obviated. Finally, the (novel, to my knowledge) observation here is that when the coreferential R-expression is contained within an interrogative which has composed with the head nominal, the condition C violation is obviated. In order to maintain a unified account of these facts, it seems desirable to assign embedded interrogatives predicative denotations.

Nominals in these environments require a prepositional element *of* to surface. This is illustrated in (214) with the PropDP *the same thing*.

(214) Bill was curious when John was leaving for Syracuse.
and Frank was curious *(of) the same thing.

(217)   a.   Which book [that John$_1$ hated most] did he$_1$ read?   *relative clause*

       b.   *Which depiction [of John$_1$'s face] does he$_1$ hate the most?*argument*

(218)   a.   The fact [that John$_1$ has been arrested] he$_1$ generally fails to mention.

       b.   Whose allegation [that Lee$_1$ was less than truthful] did he$_1$ refute vehemently?

(219)   a.   The question of [who John$_1$ likes] he$_1$ generally tends to avoid.

       b.   Which investigation into [who John$_1$ bribed] did$_1$ he successfully shut down?

3.4   ENRICHING THE NOTION OF CONTENT

What is the content of an entity such as an *issue* or *question*? At first brush, we might want to identify the content of a *question* with a Hamblin/Karttunen question denotation. I would like to go down a somewhat different route however, partially because it will allow us to give a more satisfactory account of responsive predicates. This will also involve rethinking the notion of content as applied to entities such as *facts* and *claims*. It is to this issue that I first turn.

So far, we have been treating the content of an entity as a Stalnakerian proposition, i. e., (the characteristic function of) a set of possible worlds. I argue that a richer notion of content is necessary (see also Rawlins 2013); specifically a variant of the notion of content argued for in *Inquisitive Semantics* (see, e. g., Ciardelli, Groenendijk & Roelofsen 2015 for an overview).

(220)   **Propositions (def.)** (after Ciardelli, Groenendijk & Roelofsen 2015: 31)

a. A proposition is (the characteristic function of) a non-empty, downward-closed set of worlds.

b. The set of all propositions is denoted by Π.

We can extend the current compositional setting in order to derive inquisitive propositions as sentence meanings simply by invoking the (independently motivated) distributivity operator $*$.

The way that this works in more formal terms is as follows:

- $D_{\langle s,t \rangle}$ (and more generally any domain $D_{\langle \sigma,t \rangle}$) is a *poset*, i. e. a set partially ordered by inclusion.

- A set Q is a *downset* of $D_{\langle s,t \rangle}$ if $Q \subseteq D_{\langle s,t \rangle}$ and $\forall p \forall p'[p \in Q \land p' \subseteq p \rightarrow p' \in Q]$.

- Π corresponds to the set of all downsets of $D_{\langle s,t \rangle}$ minus $\varnothing$.

- For each $p \in D_{\langle s,t \rangle}$, $\mathcal{P}(p)$ corresponds to a unique downset of $D_{\langle s,t \rangle}$ (but not vice versa).

- $*$ is defined for each $p \in D_{\langle s,t \rangle}$, and delivers $\mathcal{P}(p)$. The closure of $D_{\langle s,t \rangle}$ under $*$ is therefore a subset of Π.

The way that $*$ is defined is such that, when applied to a Stalnakerian proposition, it is guaranteed to deliver a member of Π.

(221) $[\![*]\!] = \lambda P_{\langle \sigma,t \rangle} . \lambda Q_{\langle \sigma,t \rangle} : \exists x_{\sigma}[Q(x)] . \forall x'_{\sigma}[Q(x') \rightarrow P(x')]$

To see how this works, consider the following derivation.

(222) $[\![$that Henning DJed$]\!] = \lambda w . \mathsf{H}$ DJed in w

(223) $[\![*]\!]([\![(222)]\!]) = \lambda p_{\langle s,t \rangle} : \exists w_s[p(w)] . \forall w'_s[p(w') \rightarrow \mathsf{H}$ DJed in $w']$

We only need to modify our compositional system for *wh*-questions slightly in order to deliver members of Π as question denotations. Specifically, we assign $\mathsf{C_Q}$ the meaning of $*$, rather than treating it as Partee's (1986) IDENT type-shifter.

(224) $[\![\text{which boy}]\!] = \lambda x \,.\, \text{boy}$

(225) $[\![Q]\!] = \lambda P_{\langle e,t \rangle} \,.\, \lambda K_{\langle e, \langle \langle s,t \rangle, t \rangle \rangle} \,.\, \lambda p_{\langle s,t \rangle} \,.\, \exists x_e [P(x) \wedge K(x)(p)]$

(226) $C = *$

(227)

$$\lambda p \,.\, \exists x \begin{bmatrix} \text{boy}_@(x) \\ \wedge \, \forall w \begin{bmatrix} p(w) \\ \rightarrow x \text{ left in } w \end{bmatrix} \end{bmatrix}$$

defined iff $\exists w'[p(w')]$

$$\lambda K \,.\, \lambda p \,.\, \exists x \begin{bmatrix} \text{boy}_@(x) \\ \wedge \, K(x)(p) \end{bmatrix} \qquad \lambda x \,.\, \lambda p \,.\, \forall w \begin{bmatrix} p(w) \\ \rightarrow x \text{ left in } w \end{bmatrix}$$

$$\text{Q} \qquad \lambda x \,.\, \text{boy}_@(x) \qquad\qquad \lambda x \qquad \lambda p \,.\, \forall w \begin{bmatrix} p(w) \\ \rightarrow x \text{ left in } w \end{bmatrix}$$

which boy

defined iff $\exists w'[p(w')]$

$* \qquad \lambda w \,.\, x \text{ left in } w$

t_x left
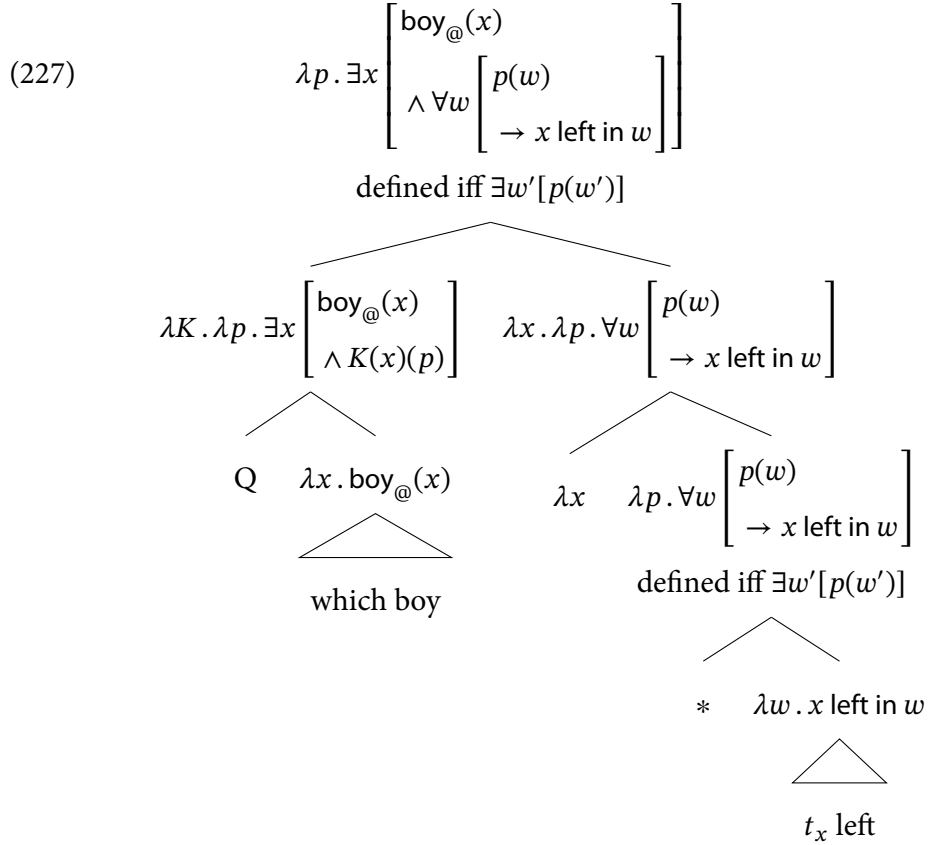
The idea then, is that both embedded declaratives and interrogatives denote *issues* in the inquisitive semantic sense.

(228) *CONT* is a function from a world $w \in D_s$, and an entity $x \in D_e$ to $x's$ unique content $Q \in D_{\langle st,t \rangle}$.

The Issues that we derive from embedded interrogatives are distinct from those that we derive from embedded declaratives, since the Issue

corresponding to an embedded declarative has a unique maximal members, whereas the issue corresponding to an embedded interrogative has multiple maximal members.

(229) Definition: $\mathrm{alt}_{\mathrm{Inq}}(I)$
The maximal elements of an issue I (written $\mathrm{alt}_{\mathrm{Inq}}(I)$) are called the alternatives in I.

(230) $[\![[_{\mathcal{C}P} \text{ that Henning DJed}]]\!] = \lambda p : \exists w[p(w)]$
$$. \forall w' \begin{bmatrix} p(w') \\ \rightarrow \text{H DJed in } w' \end{bmatrix}$$

In fact, the set containing the maximal members of the Issue denoted by an embedded interrogative corresponds to the traditional Hamblin/Karttunen question denotation.

(231) $[\![[_{\mathcal{C}P} \text{ who DJed}]]\!] = \lambda p : \exists w[p(w)]$
$$. \exists x \begin{bmatrix} \text{boy}_@(x) \\ \wedge \forall w' \begin{bmatrix} p(w') \\ \rightarrow x \text{ DJed in } w' \end{bmatrix} \end{bmatrix}$$

Naturally, we need to revise the denotation of $\mathcal{C}$ as follows:

(232) $[\![\mathcal{C}]\!] = \lambda w . \lambda Q_{\langle st, t \rangle} . \lambda x . \mathcal{CONT}_w(x) = Q$

Given that both embedded interrogatives and embedded declaratives are of type $\langle e, t \rangle$, and indeed of the same syntactic category, it is natural to wonder how we derive the selectional restrictions we've just observed.

(233) $\texttt{info} = \lambda Q . \bigcup Q$

I define two predicates over inquisitive propositions: $\texttt{informative}$ and $\texttt{inquisitive}$ (following Ciardelli, Groenendijk & Roelofsen 2015:

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pp. 28), defined in terms of the operator `info`, which takes an inquisitive proposition (a downward-closed set of propositions) and returns its union.

(234) a. `informative` $= \lambda Q . \mathsf{info}(P) \neq W$

b. `inquisitive` $= \lambda Q . \mathsf{info}(Q) \notin Q$

I claim that anti-rogative predicates carry a presupposition that the *content* of their entity argument is not `inquisitive`.

(235) a. $[\![\sqrt{\text{belief}}]\!] = \lambda w . \lambda s : \neg\mathsf{inquisitive}(\mathcal{CONT}_w(s))$
$. \, \mathsf{belief}_w(s)$

b. $[\![\sqrt{\text{claim}}]\!] = \lambda w . \lambda x : \neg\mathsf{inquisitive}(\mathcal{CONT}_w(s))$
$. \, \mathsf{claim}_w(x)$

This immediately derives the fact that anti-rogative predicates like $\sqrt{\text{belief}}$ do not compose with $\mathcal{C}$Ps derived from interrogatives. This is ultimately because the inquisitive proposition denoted by an interrogative is `inquisitive`, but $\sqrt{\text{belief}}$ presupposes that the content of its eventuality argument is not `inquisitive`. I illustrate how this works in (236).

(236)

```
                        ③ (PM)
                       /      \
                   ②              ①
                  /  \           /  \
                v   √belief_w   𝒞_w   CP
                                      /\
                                  who DJed
```

(237) $[\![①]\!] = \lambda p : \exists w'[p(w')] . \exists x \forall w''[p(w'') \rightarrow x \text{ DJed in } w'']$

(238)   **Fact: inquisitive($\llbracket ① \rrbracket$) = 1**

(239) $\llbracket ③ \rrbracket = \lambda s : \neg\texttt{inquisitive}(\mathcal{CONT}_w(s))$

$\qquad\qquad . \, \texttt{belief}_w(s)$

$\qquad\qquad \wedge \, \mathcal{CONT}_w(s) = ①$

Rogative predicates, on the other hand, I claim carry a presupposition
that the content of their entitiy argument is not **informative**.

(240)   a. $\llbracket \sqrt{\text{wonder}} \rrbracket = \lambda w . \lambda e : \neg\texttt{informative}(\mathcal{CONT}_w(e))$

$\qquad\qquad\qquad\qquad . \, \texttt{wondering}_w(e)$

$\qquad$ b. $\llbracket \sqrt{\text{question}} \rrbracket = \lambda w . \lambda x : \neg\texttt{informative}(\mathcal{CONT}_w(x))$

$\qquad\qquad\qquad\qquad . \, \texttt{question}_w(e)$

This derives the fact that rogative predicates like *wonder* and *question*
do not compose with $\mathcal{C}$Ps derived from declaratives. This is because the
inquisitive proposition denoted by a declarative is **informative**. I illus-
trate how this works in (241).

(241)
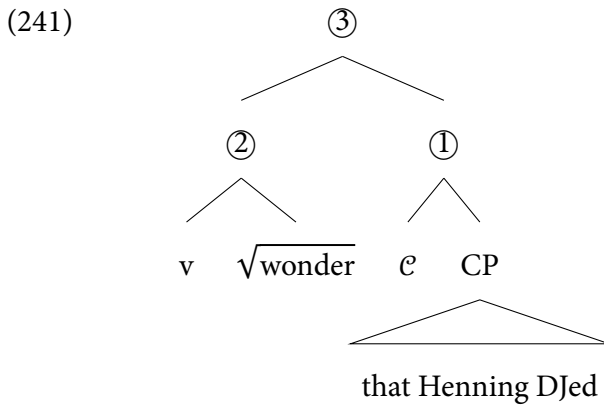
(242) $\llbracket$that Henning DJed$\rrbracket$

$\quad = \lambda p : \exists w'[p(w')]$

$\qquad\quad . \, \forall w''[p(w'') \rightarrow \text{Henning DJed in } w'']$

(243)   **Fact:** $\texttt{informative}(\llbracket ① \rrbracket) = 1$

(244) $\llbracket ③ \rrbracket = \lambda s : \neg\texttt{informative}(\mathcal{CONT}_w(s))$

$\qquad\qquad . \, \texttt{wonder}_w(s)$

$\qquad\qquad \wedge \, \mathcal{CONT}_w(s) = ①$

I will tentatively claim that responsive predicates, on the other hand, do not carry such a presupposition, and therefore are free to compose with $\mathcal{C}$Ps derived from *that*-clauses, and $\mathcal{C}$Ps derived from interrogatives, although we will need to say a little more about this.

In this section I have shown how it is possible to treat both interrogatives and declaratives as $\mathcal{C}$Ps of type $\langle e, t \rangle$, whilst retaining an account of the selectional restrictions of rogative and anti-rogative. The selectional restrictions of such predicates was captured via a presupposition restricting the *content* of the predicates eventuality argument.

Treating interrogatives as predicates has a number of theoretical advantages:

- It accounts for the fact that interrogatives can compose with nominals which denote predicates of contentful entities, such as *question*, and *issue*.

- It accounts for the fact that interrogatives can appear in the CP equative construction, as in (245).

- It accounts for the fact that interrogatives composed with nominals pattern with declaratives and relative clause with respect to bleeding of condition C.

(245)   The question is whether we should leave.

We also make a further prediction. Moulton (2017) shows that declarative 'complements' to nominals pattern with relative clause modifiers with respect to Williams' generalization. If interrogative 'complements'

to nominals are also in fact modifiers, we predict that extraposition of an interrogative should restrict the scope of its host nominal. The examples designed to test this prediction, in (246), (247), and the accompanying scenario (248), are modelled after examples involving *that*-clauses from Moulton (2017: pp. 294-295). I claim that extraposition of an interrogative 'complement' to a nominal restricts its scope in exactly the same way as extraposition of a declarative. The core observation is that, in (247), where the interrogative has been extraposed, the narrow scope reading of the host DP is bled. This intuition can be sharpened by considering the examples in the context of the scenario in (248) (where $q_{a,...,d}$ are distinct questions). (246) is judged as *true* in scenario (248), since at t_3 John has dismissed every question, whereas at t_3 Mary has not yet dismissed every question; this is the reading where the universal takes scope beneath the *before*-clause. (247) is judged false in scenario (248) however, since there is at least one question, q_a for example, which Mary dismissed before John did. For (247) to be true, it must be the case that for each question q, John dismissed q before Mary did; this is the reading where the universal takes scope above the *before*-clause. The fact that (247) imposes this more stringent requirement indicates that it does not have a reading on which the universal takes scope below the *before*-clause.

(246)   John dismissed every question of [whether he is resigning] before Mary did.

$$\forall > \text{before} / \text{before} > \forall$$

(247)   John dismissed every question before Mary did of [whether he is resigning].

$$\forall > \text{before} / *\text{before} > \forall$$

(248) t_1 Mary dismissed q_a

                 John dismissed q_a

       t_2 Mary dismissed q_b

       t_3 Mary dismissed q_c

                 John dismissed q_b, q_c, and q_d

       t_4 Mary dismissed q_d

3.5   EMBEDDED INTERROGATIVES AND SUBSTITUTION FAIL-URES

Examples can be constructed illustrating *substitution failures* for interrogatives, in just the same way as we have seen for *that-clauses*. If the embedded interrogative "which students left early" denotes the question of which students left early, we might reasonably expect "which students left early" and "the question of which students left early" to be substitutable *salva veritate*. As illustrated by the examples in (249) this is not the case. (249a) entails that Henry believes the true answer to the question *which students left early*, whereas (249b) simply entails that Henry is *acquainted with* the question *which students left early*.

(249)   a.   Henry knows which students left early.

        b.   Henry knows the question (of) which students left early.

Just as in the case of *that*-clauses, we can construct examples showing that it is not a shift in syntactic category that is responsible for the meaning shift in (249b). This is illustrated in (250). The PROPDP *this exact thing* is anaphoric on the question *which students left early*, and correspondingly the sense of $\sqrt{\text{know}}$ in the second conjunct mirrors the sense of $\sqrt{\text{know}}$ in the first conjunct.

(250)   Henry knows which students left early,
and Richard has been wondering this exact thing.

We can account for this in just the same way as we did with substitution failures involving *that*-clauses. Specifically, I will assume that the nominal *question* simply denotes a set of abstract entities that are *questions*.

(251) $[\![\text{question}]\!] = \lambda w . \lambda x . \text{question}_w(x)$

The DP *the question of which students left early* as such comes to denote an abstract *question* entity, the content of which is specified by the embedded $\mathcal{C}$P.

(252)   ① $\iota x \begin{bmatrix} \text{question}_w(x) \\ \mathcal{CONT}_w(x) \\ = \lambda p . \exists X \begin{bmatrix} \text{students}_w(X) \\ \wedge \forall w'' \begin{bmatrix} p(w'') \\ \rightarrow X \text{ left early in } w'' \end{bmatrix} \end{bmatrix} \end{bmatrix}$

$\langle et, e \rangle$ $\langle e, t \rangle$

the

$\langle e, t \rangle$ $\langle e, t \rangle$

$\mathcal{C}_w$P

v $\sqrt{\text{question}}_w$

which students

left early

Since the DP denotes an individual, it must be integrated into the LF as the specifier of an argument-introducing head, in this case F_{int}. This explains the fact the substitution failure with the nominal assumption,

on the assumption that $\sqrt{\text{know}}$ is interpreted as something like acquaintance when it takes an internal argument.

(253) $[\![\sqrt{\text{know}}]\!] \leftrightarrow \lambda w \,.\, \lambda s \,.\, \text{knowledge}_w(s)$

$\leftrightarrow \lambda w \,.\, \lambda s \,.\, \text{acquaintance}_w(s) \,/\, [\text{ F}_{\text{int}} \underline{\quad}]$

An embedded interrogative on the other hand will compose with the predicate via PM just like a *that*-clause.

(254) $\lambda w \,.\, \exists s \begin{bmatrix} \mathcal{HOLDER}_w(s) = \text{Henry} \\ \wedge\, \text{knowledge}_w(s) \\ \wedge\, \mathcal{CONT}_w(s) \\ \quad = \lambda p \,.\, \exists X \begin{bmatrix} \text{students}_w(X) \\ \wedge\, \forall w'' \begin{bmatrix} p(w'') \\ \rightarrow X \text{ left early in } w'' \end{bmatrix} \end{bmatrix} \end{bmatrix}$
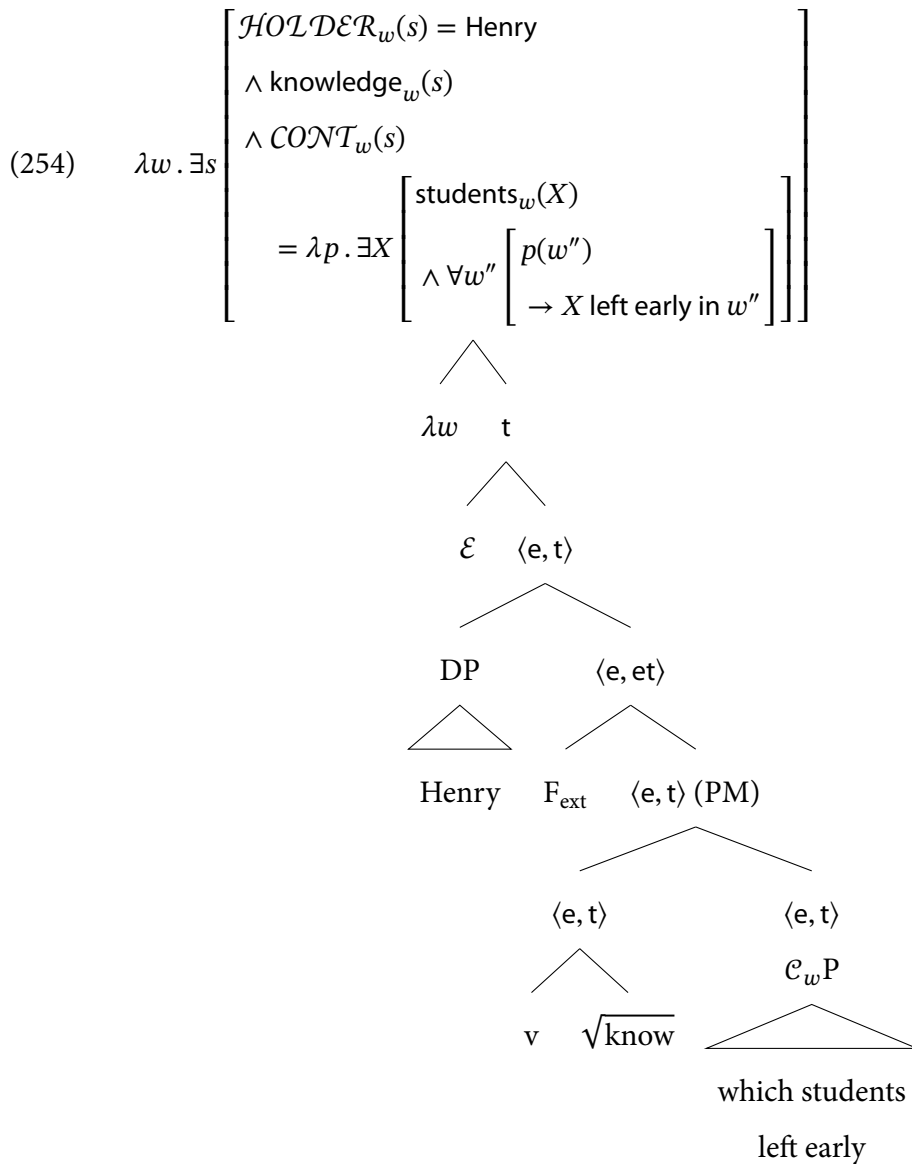
The conjecture that embedded interrogatives, like *that*-clauses, denote *predicates*, suggests that embedded interrogatives should give rise to an *explanans* reading with *explain*, since much like an embedded *that*-clause, an embedded interrogative is predicted to specify the *content* of the explaining event. This prediction is borne out. Consider the example in (255).

(255)   John explained which girl won the race.

(255) clearly has an *explanans* reading – the *content* of John's explanation is the proposition that is the answer to *which girl won the race*. Crucially, 255 doesn't seem to have an *explanandum* reading. The hypothetical explanandum reading would mean something like the following: John gave an explanation *for* the answer to which girl won the race. E. g., if Mary won the race, John said that Mary trained really hard. (255) is however intuitively not true in this context.

A putative counter-example to the claim that embedded interrogatives have an *explanans* reading is the case of *why*-questions. Consider, e. g., (256), which one might think, on the face of it, is an explanans reading.

(256)   Jeff explained [why Shirley is upset].

This *must* be an explanans reading however. This is because the *answer* to a *why*-question is itself a reason – in this case, a reason for Shirley being upset. If the answer to the question was an *explanandum*, then (256) would mean something like the following: Jeff gave an explanation for the proposition that is the reason for Shirley being upset. This is clearly not what (256) means however – the answer to the embedded *why*-question is an *explanans*. We can paraphrase the reading that (256) receives as: Jeff gave an explanation, the content of which was the reason for Shirley being upset.

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3.7 THE SEMANTICS OF RESPONSIVE PREDICATES

There are two major families of approaches to the semantics of responsive predicates such as *know*: following Elliott et al. (2017) I will dub these the Question-to-Propostion Reduction (Q-TO-P) approach, and the Proposition-to-Question Reduction (P-TO-Q) approach.[6]

As we have observed *responsive* predicates such as $\sqrt{\text{know}}$ and $\sqrt{\text{tell}}$ may embed both declaratives and interrogatives. This is generally considered to be a problem, in the sense that declaratives and interrogatives are generally taken to denote distinct kinds of semantic object. For example, it is reasonably standard to assume that declaratives denote propositions, i. e., the characteristic function of a set of possible worlds, of type $\langle s, t \rangle$, whereas interrogatives have Hamblin/Karttunen question-denotations, i. e., the characteristic functions of a set of propositions, of type $\langle st, t \rangle$. It might therefore seem reasonable at first blush to propose that responsible predicates such as $\sqrt{\text{tell}}$ are actually ambiguous between two homophonous predicates: $\sqrt{\text{tell}_P}$, and $\sqrt{\text{tell}_Q}$, of type $\langle st, \langle e, t \rangle \rangle$, and type $\langle \langle st, t \rangle, \langle e, t \rangle \rangle$ respectively. $\sqrt{\text{tell}_P}$ relates an attitude holder to a proposition, and $\sqrt{\text{tell}_Q}$ relates an attitude holder to a question.

As pointed out by Elliott et al. (2017), we can immediately dismiss this as a theoretical possibility on the basis of data from coordination (see also Groenendijk & Stokhof 1984). (257) shows that an interrogative and declarative clause may be embedded under a single occurrence of $\sqrt{\text{know}}$. This fact holds for responsive predicates more generally. One could commit to a conjunction reduction analysis (see, e. g., Hirsch 2016, 2017, Schein 2017 for a recent defence of conjunction reduction), as in (258). Accidental homophony is not generally sufficient to license ellipsis however, as illustrated by the contrast in (259) (which involves an elliptical construction involving pseudogapping). 'bank$_1$' stands for the *deposit in a bank* sense, and 'bank$_2$' stands for the *turn* sense.

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6 Note that this section builds primarily upon joint work with Nathan Klinedinst, Yasutada Sudo, and Wataru Uegaki, published as Elliott et al. 2017.

(257)   Mary knows [which student came] and [that none of the professors came].

(Elliott et al. 2017: pp. 2)

(258)   Mary knows [which student came] and ~~Mary knows~~ [that none of the professors came].

(259)   a.   John banked$_1$ his pension as Bill did ~~bank$_1$~~ his payslip.

    b.   #John banked$_2$ his pension as the plane did ~~bank$_2$~~ left.

The Q-TO-P approach accounts for responsivity, by assuming that the *basic* meaning of a responsive predicate relates an attitude holder to a proposition, and embedded interrogatives come to denote propositions (see, e. g., Heim 1994, Dayal 1996, Lahiri 2002, Spector & Egré 2015). The P-TO-Q approach on the other hand, assumes that the *basic* meaning of a responsive predicate relates an attitude holder to a question, and embedded declaratives come to denote (resolved) questions (Groenendijk & Stokhof 1984, Uegaki 2015b,a, Theiler, Roelofsen & Aloni 2016). Elliott et al. (2017) flesh this out by assuming that embedded interrogatives have Hamblin/Karttunen denotations, whereas embedded declaratives denote singleton sets of propositions. The approach adopted here in more akin to Theiler, Roelofsen & Aloni 2016: both interrogative and declarative CPs denote inquisitive propositions, but differ as to whether they have a unique alternative, or multiple alternatives.[7]

3.7.1   *An argument against the Q-to-P approach*

Elliott et al. (2017) observe that (260b) presupposes that the embedded declarative is true, and that Mary knows it. (260a) on the other hand

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7 An "alternative" in the inquisitive semantic sense is a maximal element in a set of downward closed propositions. Declaratives denote inquisitive propositions with a unique maximal element, whereas interrogatives denote inquisitive propositions with multiple alternatives (technically, just so long as there are finitely many possible worlds). See Ciardelli, Groenendijk & Roelofsen 2015 for a detailed reference.

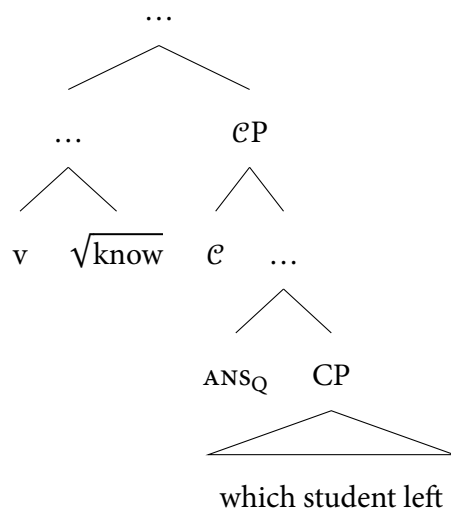does not seem to presuppose that Mary believes any one answer to the embedded question.

(260) a. Mary cares [which student left].

    b. Mary cares [that John left].

(Elliott et al. 2017: pp. 3)

The data in (260) is problematic for the Q-to-P approach. Recall that on this approach responsive predicates are taken to basically select for propositions. Q-to-P reduction is typically accomplished via some operation that takes a question (say, a Hamblin/Karttunen denotation) and returns a proposition that is an answer to that question. This is accomplished either via a covert answerhood operator (Heim 1994, Dayal 1996, Beck & Rullmann 1999, Fox 2012), raising of the interrogative clause, which is taken to leave behind a variable of a propositional type (Lahiri 2002), or via meaning postulates which define a question-embedding sense of the predicate in terms of the proposition embedding sense (Karttunen 1977, Spector & Egré 2015). This is because the basic intuition is that (260a) does not entail that *Mary* is in the $care_P$ relation to an answer to the question *which student left?*
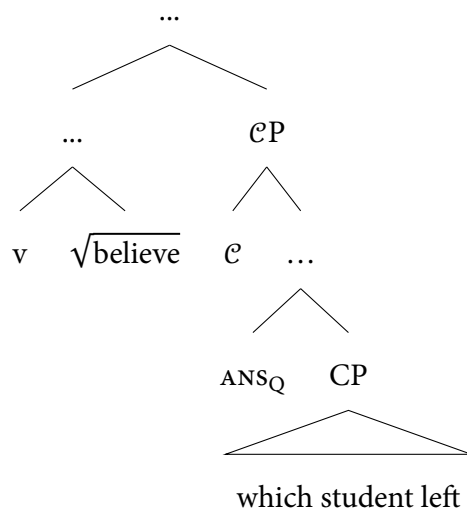
An advantage of the account adopted here is that we can readily account for the interpretation of $\sqrt{care}$ with both embedded interrogatives and declaratives. Furthermore, we are wedded to the P-to-Q approach rather than a Q-to-P approach. To consider why, consider a hypothetical operator ANS$_Q$. ANS$_Q$ takes an interrogative meaning *I* containing multiple alternatives, and a world *w*. It is defined if and only if there exists a unique, maximally informative alternative $p \in I$ such that $p(w) = 1$, It returns *p*. See Dayal 1996, Fox 2012 for precise formulations. The structure of an embedded interrogative under a responsive predicate would therefore look as follows:

(261)

```
                        …
                ┌───────┴───────┐
              …                  𝒸P
          ┌───┴───┐          ┌───┴───┐
          v      √‾know      𝒸       …
                                  ┌──┴──┐
                               ANS_Q   CP
                                    ┌───┴───┐
                              which student left
```

There is nothing immediately problematic about the LF in (261) but it faces two serious problems: (i) if of course fails to account for the data we have raised involving $\sqrt{\text{care}}$, and (ii) it makes the selectional restrictions of anti-rogative predicates such as $\sqrt{\text{belief}}$ impossible to state. This is because anti-rogative predicates simply carry a presupposition that the content of their eventuality argument is not-inquisitive. There is nothing to prevent then, an embedding configuration such as the following:

(262)

```
                        …
                ┌───────┴───────┐
              …                  𝒸P
          ┌───┴───┐          ┌───┴───┐
          v     √‾believe    𝒸       …
                                  ┌──┴──┐
                               ANS_Q   CP
                                    ┌───┴───┐
                              which student left
```

In fact, because of the syntactic assumptions we have made, we *must*. Interrogative and declarative complements are taken to be of the same category: $\mathcal{C}$P, and the same semantic type: $\langle e, t \rangle$. It is therefore impossible to formulate contextual allosemy rules that make the interpretation of $\sqrt{\text{care}}$ (or indeed any predicate) sensitive to whether it embeds an interrogative or a declarative, whilst maintaining the assumption that contextual allosemy rules are subject to strict locality (Jonathan David Bobaljik 2012).

(263) $[\![\sqrt{\text{care}}]\!] = \lambda w \,.\, \lambda s \,.\, \text{care}_w(s)$

The interpretation rule for the argument introducing head (264), in tandem with $\sqrt{\text{care}}$ looks horrendous, but it is really rather simple. It simply introduces a presupposition which states that the experiencer of the caring event believes that a maximal member of the content of the caring event is true.

(264) $[\![\text{F}_{\text{int}}]\!]$

$$
\leftrightarrow \lambda w \,.\, \lambda f \,.\, \lambda x \,.\, \lambda e \;:\; \exists s
\begin{bmatrix}
\text{belief}_w(s) \\
\wedge\, \mathcal{EXP}_w(s) = x \\
\mathcal{CONT}_w(s) \\
= \lambda p \,.\, \forall w'
\begin{bmatrix}
p(w') \\
\rightarrow \exists p
\begin{bmatrix}
p(\text{MAX}(\mathcal{CONT}_w(e))) \\
\wedge\, p(w')
\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

$. \, \mathcal{EXP}_w(e) = x$

$\wedge\, f(e)$

$/\, [\,\underline{\quad}\, \sqrt{\text{care}} \,]$

Let's begin by considering how the interpretation rule for F_{int} in tandem with the assumptions we have been making thus far.

(265) $[\![(260b)]\!] = \lambda w : \exists s \begin{bmatrix} \text{belief}_w(s) \\ \wedge\ \mathcal{EXP}_w(s) = \text{Mary} \\ \wedge\ \mathcal{CONT}_w(s) \\ \quad = \lambda p . \forall w' \begin{bmatrix} p(w') \\ \rightarrow \text{John left in } w' \end{bmatrix} \end{bmatrix}$

$.\exists s' \begin{bmatrix} \text{caring}_w(s) \\ \wedge\ \mathcal{EXP}_w(s) = \text{Mary} \\ \wedge\ \mathcal{CONT}_w(s) \\ \quad = \lambda p . \forall w' \begin{bmatrix} p(w') \\ \rightarrow \text{John left in } w' \end{bmatrix} \end{bmatrix}$

(266) ① $= \lambda p . \exists x \begin{bmatrix} \text{student}_w(x) \\ \wedge\ \forall w' \begin{bmatrix} p(w') \\ \rightarrow x \text{ left in } w' \end{bmatrix} \end{bmatrix}$

If, e.g., the students are Nick, Bruno and Liz, then MAX applied to ⊠ will return the set of propositions in (267).

(267) $\left\{ \begin{array}{l} \text{Nick left,} \\ \text{Bruno left,} \\ \text{Liz left} \end{array} \right\}$

(268) therefore presupposes that Mary believes that one of the propositions in (267) is true, and asserts that the content of Mary's caring state is the Issue of which student left.

(268) $[\![(260\text{a})]\!] = \lambda w : \exists s \begin{bmatrix} \text{belief}_w(s) \\ \wedge\, \mathcal{EXP}_w(s) = \text{Mary} \\ \wedge\, \mathcal{CONT}_w(s) \\ \quad = \lambda p\,.\,\forall w' \begin{bmatrix} p(w') \\ \rightarrow \exists p' \begin{bmatrix} (\text{MAX}(\boxtimes))(p') \\ \wedge\, p'(w') \end{bmatrix} \end{bmatrix} \end{bmatrix}$
$\qquad\qquad .\,\exists s' \begin{bmatrix} \text{caring}_w(s) \\ \wedge\, \mathcal{EXP}_w(s) = \text{Mary} \\ \wedge\, \mathcal{CONT}_w(s) = \boxtimes \end{bmatrix}$

4

ATTITUDES AND PLURALITY

IN THIS CHAPTER I elaborate on the semantics of attitude reports. The chapter is split into two broad sections. In §4.1, I argue explicitly that the relation between a contentful entity and the content specified by a *that*-clause is *equality* rather than entailments. This raises an issue, as it seems to make the incorrect prediction that attitude reports, such as belief reports, are existential statements about the totality of an individuals beliefs. The remainder of the chapter is devoted to reconciling the evidence for equality with a more orthodox semantics for attitude reports. In order to this, a boolean theory of plurality is integrated with the neo-Davidsonian event semantics argued for in previous chapters.

4.1   EQUATION OR ENTAILMENT?

There is some overlap between the semantics of clausal embedding here, and that proposed in Hacquard 2006. Where the two accounts crucially differ is that, here, the relation between the eventuality argument of the attitude verb and its content is *equality*, whereas according to Hacquard, they are related via *entailment*. I will present arguments here showing that, in order to explain certain facts, the relation between the eventuality and its content must be equality, this informing our analysis of the semantics of $\mathcal{C}$. Hacquard's semantics for attitude verbs are illustrated by the logical representation below, for a belief report.

"A person's life consists of a collection of events, the last of which could also change the meaning of the whole, not because it counts more than the previous ones but because once they are included in a life, events are arranged in an order that is not chronological but, rather, corresponds to an inner architecture."

— *Mr. Palomar,* Italo Calvino

(269) ⟦Darcy believes that it is raining⟧

$$\exists s \begin{bmatrix} s \text{ in } w* \\ \wedge\ \tau(s) \subseteq t* \\ \wedge\ \mathcal{EXP}(s) = \text{Darcy} \\ \wedge\ \text{belief}(s) \\ \wedge\ \forall w' \in \mathcal{CONT}(s) : \text{it is raining at } \tau(s) \text{ in } w' \end{bmatrix}$$

(270) $\mathcal{CONT}(s) = \bigcap \mathcal{P}$

where $\mathcal{P} = \{p : p \text{ is a belief of } \mathcal{EXP}(s) \text{ at } \tau(s)\}$

What Hacquard's denotation in (269) says, in more informal terms, is the following: There is a state, s, such that:

- s is an actual state.

- the runtime of the state contains the utterance time.

- Darcy is the experiencer of s

- s is a belief state.

- The content of s (i.e., Darcy's total beliefs at $\tau(s)$) entail that it is raining.

We can isolate the crucial final assumption by translating Hacquard's proposal into the framework assumed here.

(271) ⟦Darcy believes that it is raining⟧

$$= \lambda w\,.\, \exists s \begin{bmatrix} \mathcal{EXP}_w(s) = \text{Darcy} \\ \wedge\ \text{belief}_w(s) \\ \wedge\ \forall w' \in \mathcal{CONT}_w(s) : \text{it is raining in w}' \end{bmatrix}$$

What Hacquard proposes, informally, is the following Logical Form for a belief report: there exists a belief state s of Darcy's such that the content s entails that it is raining. Hacquard takes the content of s to be

the intersection of Darcy's beliefs. So, in other words, for 271 to be true, Darcy's beliefs must entail that it is raining.

An apparent advantage of Hacquard proposed Logical Form for belief reports is that it captures entailments such from (272a) to (272b). This is because, if Darcy's beliefs entail that it is raining heavily, then it follows that Darcy's beliefs entail that it is raining.

(272)　a.　Darcy believes that it is raining heavily.

　　　　b.　Darcy believes that it is raining.

The proposal here does not capture this entailment however. To see why, consider the Logical Forms below:

(273)　a.　$\lambda w \, . \, \exists s \begin{bmatrix} \mathcal{EXP}_w(s) = \text{Darcy} \\ \wedge \, \text{belief}_w(s) \\ \wedge \, \mathcal{CONT}_w(s) = \lambda w' \, . \, \text{it is raining heavily in } w' \end{bmatrix}$

　　　　b.　$\lambda w \, . \, \exists s \begin{bmatrix} \mathcal{EXP}_w(s) = \text{Darcy} \\ \wedge \, \text{belief}_w(s) \\ \wedge \, \mathcal{CONT}_w(s) = \lambda w' \, . \, \text{it is raining in } w' \end{bmatrix}$

Nothing we have said guarantees that, if there exists a state s that satisfies the conjuncts in (273a), this guarantees the existence of a state s' that satisfies the conjuncts in (273b). This would seem to be a fairly basic requirement for a theory of belief reports, and we come back to this question in Chapter 4.

Nevertheless, we can argue on independent grounds that the relationship between the content of a contentful individual and the proposition denoted by the clause it composes with is *equation* rather than *entailment*. We can isolate the two different accounts by considering two possible denotations for a putative operator $\mathcal{C}$ that takes a classical proposition and gives back a predicative *that*-clause denotation. ① represents the semantics argued for here, and ② represents the semantics argued for by Hacquard (2006).

(274) $[\![\mathcal{C}]\!] = \begin{cases} ① \ \lambda w_s \,.\, \lambda p_{\langle s,t \rangle} \,.\, \lambda x_e \,.\, \mathcal{CONT}_w(x) = p \\[2ex] ② \ \lambda w_s \,.\, \lambda p_{\langle s,t \rangle} \,.\, \lambda x_e \,.\, \forall w'[\mathcal{CONT}_w(x)(w') \rightarrow p(w')] \end{cases}$

The argument comes from an interesting restriction on the definiteness of content nouns such as *fact* and *proposition*.[1]

(275) a. Darcy mentioned a fact (*that it's raining).

     b. Darcy mentioned the fact (that it's raining).

     c. Darcy mentioned two facts (*that it's raining).

(276) a. Darcy mentioned a rumour (that it's raining).

     b. Darcy mentioned the rumour (that it's raining).

     c. Darcy mentioned two rumours (that it's raining).

Notice the contrast between the content nouns *fact* and *rumour*, as illustrated by the examples in (275) and (276) respectively. When it composes with a *that*-clause, *fact* is only acceptable with the definite article, and no other determiner.

We have a ready explanation for this pattern based on the assumption that $\mathcal{C}$ encodes *equation* rather than entailment. Heim (1991) observes that the distribution of the indefinite article *a* in English is constrained by a non-uniqueness condition, as illustrated by examples such as those in (277) (from Heim 1991[2]).

(277) a. {*a | the} weight of our tent is under 4lb.

     b. {*a | the} I interviewed a biological father of the victim.

Heim proposes to analyze the unacceptability of the indefinite article in such examples as a special case of Maximize Presupposition! (MP!).[3]

---

1 Thanks to Ed Keenan for suggesting this line of thought. Any errors in reasoning are, needless to say, my responsibility.

2 I've modified (277b) to make reference to *biological father* rather than simply *father*.

3 A formulation of MP!, after Uli Sauerland 2008 is given in (278).

(281)   In utterance situations where the presupposition for [*the ζ*] *ξ* is already known to be satisfied, it is not permitted to utter [*a ζ*] *ξ*.

Since it is common knowledge that tents have a unique weight, and victims have unique biological fathers, the uniqueness presupposition of the definite article is guaranteed to be satisfied. It follows from the condition in 281 that it is not permitted to use the indefinite article in examples (277a) and (277b).

Now consider the following Logical Forms. (283) is the Logical Form we predict for *Darcy considered the fact that it's raining* on the assumption that the relation between the content of an individual and the *that*-clause denotation is *equation*. Now, assuming that it is true that it is raining, it is common knowledge that there is a unique *fact* which has as its content the proposition *that it's raining*, given the facts in (282). It follows that the presupposition of (283), *that there exists a unique fact with the content 'that it's raining'* will always be satisfied in a context where it is common

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(278)   Do not use S in a context set c only if there is no such $S' \in \text{Alt}(S)$ such that.

   a. $c \subset \text{dom}(\llbracket S' \rrbracket)$

   b.   You believe S' to be true.

   c. $\text{dom}(\llbracket S' \rrbracket) \subset \text{dom}(\llbracket S \rrbracket)$

What the definition in (278) says, in plain English, is that, S is blocked if there is an alternative to S, S', which is presuppositionally stronger than S, and is defined and believed to be true.
Uli Sauerland gives an intensional characterization of the *alternatives* to S based on the notion of a scale.

(279) $\text{Alt}(S) = \{S' \mid S \text{ and } S' \text{ differ only in replacements scalar expressions with their scalemates}\}$

For our purposes, it is important that the set in (280) constitutes a scale.

(280) $\{... \text{a}, \text{the} ...\}$

With these assumptions in hand, we derive the condition in (281) as a special case of MP!.

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knowledge that it is raining. It follows from the condition in (281) that the indefinite article will be ruled out.

(282) a. Two *facts* are distinct iff they have distinct content.

     b. In w, every proposition p s.t. $p(w) = 1$ is the content of a unique *fact* in w, and every *fact* in w has as its content a unique proposition p s.t. $p(w) = 1$.

$$(283) \quad \lambda w : \exists!x' \begin{bmatrix} \mathsf{fact}_w(x) \\ \wedge\ \mathcal{CONT}_w(x) \\ = \lambda w'\,.\,\text{it's raining in } w' \end{bmatrix} \quad\quad \Leftarrow \textit{presupposition}$$

$$\quad\quad .\, \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \mathsf{Darcy} \\ \wedge\ \mathsf{mentioning}_w(e) \\ \wedge\ \mathcal{TH}_w(e) \\ = \iota x \begin{bmatrix} \mathsf{fact}_w(x) \\ \wedge\ \mathcal{CONT}_w(x) \\ = \lambda w'\,.\,\text{it's raining in } w' \end{bmatrix} \end{bmatrix} \quad \Leftarrow \textit{assertion}$$

Compare the Logical Form predicted for *Darcy considered the fact that it's raining* on the assumption that the relation between the content of an individual and the *that*-clause denotation is *entailment*. The facts in (282) fail to guarantee that there exists a unique fact, the content of which *entails* that it is raining. For example, if, in w, it is raining heavily and it is Tuesday, there exist at least four facts, the content of which entail that it is raining: *the fact that it is raining heavily* and *the fact that it is raining, the fact that it is Tuesday and it is raining*, and *the fact that it is Tuesday and it is raining heavily*. In a world such as this, the presupposition introduced by the definite article is not satisfied.

(284) $\lambda w : \exists! x' \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \forall w'[\mathcal{CONT}_w(x)(w') \\ \rightarrow \text{it's raining in } w'] \end{bmatrix}$

$. \exists e \begin{bmatrix} \mathcal{AG}_w(e) = \text{Darcy} \\ \wedge \, \text{mentioning}_w(e) \\ \wedge \, \mathcal{TH}_w(e) \\ = \iota x \begin{bmatrix} \text{fact}_w(x) \\ \wedge \, \forall w'[\mathcal{CONT}_w(x)(w') \\ \rightarrow \text{it's raining in } w'] \end{bmatrix} \end{bmatrix}$

We have shown that the definiteness restriction we observe with content nouns such as *fact* follows straightforwardly if $\mathcal{C}$ encodes *equation* between the content of an individual and a proposition, but *not* if $\mathcal{C}$ encodes entailment. Recall that the definiteness restriction does not obtain with content nouns such as *rumour*. This is because, intuitively, two rumours may be distinct even if they have identical content. For example, John may start a rumour that it is raining, and Mary may, separately, start a rumour that it is raining. The fact that the two rumours have distinct originators is, apparently, sufficient to render them distinct. One way of formalizing this is to assume that *rumour* entails the existence of a speech act (which we take to simply be a saying event), the content of which is identical to the content of the rumour itself.[4]

(286) $[\![\text{rumour}]\!] = \lambda w . \lambda x . \text{rumour}_w(x)$

$\wedge \, \exists e \begin{bmatrix} \text{saying}_w(e) \\ \wedge \, \mathcal{CONT}_w(e) = \mathcal{CONT}_w(x) \end{bmatrix}$

---

4 This is clearly an entailment rather than a presupposition, since 285 does not imply that anyone said that Denholm is fraud, but conversely seems to imply that nobody did.

(285)   There isn't any rumour that Denholm is a fraud.

Note that it is not plausible to treat *rumour* as simply denoting a predicate of saying events. If this were true, the predication in 287 would be unexpected, since *rumours* but not eventualities spread quickly.

(287)   The rumour that Denholm is a fraud spread quickly.

Furthermore, *rumour* does not take an external argument, as illustrated by its incompatibility with a *by*-phrase (288b); contrast with a genuinely eventive nominal such as *claim* (288a).

(288)   a.   I listened carefully to the claim (by Jen) that Denholm is a fraud.

       b.   I listened carefully to the rumour (*by Jen) that Denholm is a fraud.

The fact that two rumours can be distinct despite having the same content explains why, when it composes with a *that*-clause, *rumour* is still compatible with both the definite and indefinite article. *the rumour that p* presupposes that there is a unique rumour, the content of which is *p*, and *a rumour that p* gives rise to an implicated presupposition that there exists more than one rumour, the content of which is *p*, as predicted by application of MP!, as defined in (278).

$$\iota x \begin{bmatrix} \mathsf{fact}_w(x) \\ \wedge\ \mathcal{CONT}_w(x) \\ = [\lambda w' . \exists e[\mathsf{raining}_{w'}(e)]] \end{bmatrix} \qquad (289)$$

$\lambda P . \iota x[P(x)]$ $\lambda x . \mathsf{fact}_w(x)$

the $\wedge\ \mathcal{CONT}_w(x)$

$= [\lambda w' . \exists e[\mathsf{raining}_{w'}(e)]]$

$\lambda x . \mathsf{fact}_w(x)$ $\lambda x . \mathcal{CONT}_w(x)$

fact_w $= [\lambda w' . \exists e[\mathsf{raining}_{w'}(e)]]$

$\lambda p . \lambda x . \mathcal{CONT}_w(x)$ $\lambda w' . \exists e[\mathsf{raining}_{w'}(e)]$

$= p$

$\mathcal{C}_w$ that it's raining

Note that the argument put forward here for equation on the basis of the definiteness restriction also provides an indirect argument against proposals that the *that*-clause in *the fact that it is raining* is an appositive modifier that composes with *the fact*. The *that*-clause must be in the restrictor of the definite article in order to explain the definiteness restriction.[5]

We've concluded then, that a semantics for $\mathcal{C}$ should be stated in terms of *equality* rather than entailment. This poses a rather obviously problem for the semantics of attitude reports, the meanings of which appear to be

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5 Examples such as the following show fairly definitively that the *that*-clause must be low in the nominal projection.

(290)   I carefully listened to each boy's claim that his father was mistreating him.

far too strong. Consider, e. g., the Logical Form of a *belief* report, such as *Jeff believes that Shirley is upset*, given below.

$$(291) \quad \lambda w \, . \, \exists e \begin{bmatrix} \mathcal{EXP}_w(s) = \mathsf{Jeff} \\ \wedge \, \mathsf{belief}_w(s) \\ \wedge \, \mathcal{CONT}_w(s) = \mathsf{Shirley \ is \ upset} \end{bmatrix}$$

The Logical Form states that there is a belief state s of Jeff's, the content of which is that Shirley is upset. If, at any given time, an individual holds a single belief state, then this Logical Form is far to strong, as it conveys that all that Jeff believes is that Shirley is upset. It is to this issue we turn now, and the assumption we will need to abandon is that, at any given time, an individual holds a single belief state. Rather, at any given time, an individual will be taken to hold a plurality of belief states, which are closed under boolean meet. This means that, if Jeff is the experiencer of a belief state s_1, and also the experiencer of a belief state s_2, then it follows that Jeff is the experiencer of a plural belief state $\{s_1, s_2\}$. A consequence of this view is that conceiving of belief reports as existential statements about belief states will no longer result in a semantics that is too strong.

4.2   BOOLEAN ALGEBRAS

The idea, informally, is as follows. At any given time, an individual is the *experiencer* of a plurality of belief states. An individual's belief states form a boolean algebra, and crucially, are closed under boolean meet. Here I provide an introduction to *boolean algebras*, largely following Winter 2001 and Keenan & Faltz 1984.

(292)   **Definition: Boolean Algebra**

Let A be a non-empty set (called the *domain* of the algebra). Let $\vee$, $\wedge$, and $^-$ be functions such that for ever $x, y \in A : x \vee y \in A$, $x \wedge$

$y \in A$, and $\overline{x} \in A$.[6] A structure $\langle A, \wedge, \vee, ^{-} \rangle$ is a *boolean algebra*[7] if the following hold for every $x, y, z \in A$:

a. $x \vee y = y \vee x, x \wedge y = y \wedge x$

<div align="right">*commutative laws*</div>

b. $x \vee (y \vee z) = (x \vee y) \vee z, x \wedge (y \wedge z) = (x \wedge y) \wedge z$

<div align="right">*associative laws*</div>

c. $(x \vee y) \wedge y = y, (x \wedge y) \vee y = y$

<div align="right">*absorption laws*</div>

d. $x \vee (y \wedge z) = (x \vee y) \wedge (x \vee z), x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$

<div align="right">*distributive laws*</div>

e. $(x \vee \overline{x}) \wedge y = y, (x \wedge \overline{x}) \vee y = y$

(293) **Definition: Domination**

An element x in a boolean algebra A *dominates* an element $y \in A$ iff $x \vee y = y$ iff $x \wedge y = x$. This is denoted by $y \leq x$

(294) **Definition: Zero and Unit elements**

The *zero* and *unit* elements of a boolean algebra A are defined as follows for arbitrary $x \in A$:[8]

a. $0 = x \vee \overline{x}$

b. $1 = x \wedge \overline{x}$

The notion of a *boolean algebra* generalizes naïve set theory. Given a non-empty set X, 295 is a boolean algebra. $\subseteq$ is the domination relation of the boolean algebra x, $\varnothing$ is the zero element and X is the unit element.

(295) $\langle \mathcal{P}(X), \cap, \cup, ^{-} \rangle$

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6 $\vee, \wedge, ^{-}$ are called the *join*, *meet* and *complement* operators respectively.

7 We will simply refer to *the boolean algebra A* if the operators are clear from the context.

8 Importantly, each boolean algebra A has the property that: for all $x, y \in A : x \vee \overline{x} = y \vee \overline{y}$ and $x \wedge \overline{x} = y \wedge \overline{y}$

One concept that will be important in what follows is the concept of a *homomorphism*. A homomorphism is a function f, where $\text{dom}(f)$ is a boolean algebra A, and $\text{range}(f)$ is a boolean algebra B, and which is *structure preserving*, i. e., it commutes with the boolean operations. We will say say $CONT$ is a homomorphism from the boolean algebra of belief states of an individual S_x to the boolean algebra of propositions P, since for any belief states s_1, and s_2, if (296a) holds then (296b) holds.

(296)　a.　$CONT(\{s_1\}) = p$ and $CONT(\{s_2\}) = q$

　　　　b.　$CONT(s_1 \wedge s_2) = p \wedge q$

4.3　BOOLEAN TYPES AND DOMAINS

Following Winter 2001, I elucidate the intuitive connection between boolean algebras and type-theoretical domains by defining the set of *boolean* types, and polymorphic boolean operators using lambda notation. The boolean types are those whose domains correspond to boolean algebras.[9]

(297)　**Definition: boolean types**
　　　$\text{type}_\text{B} = \{\tau \in \text{type} \mid \tau = t \vee \tau = \langle \sigma_1 \in \text{type}, \sigma_2 \in \text{type}_\text{B} \rangle\}$

9　As a notational shorthand, in polymorphic denotations I use σ as a type variable ranging over members of type and τ as a type variable ranging over members of type_B.

$$(298) \quad \sqcap_{\langle\tau,\langle\tau,\tau\rangle\rangle} \quad = \begin{cases} \wedge_{\langle t,\langle t,t\rangle\rangle} & \tau = t \\ \lambda X_\tau . \lambda Y_\tau . \lambda Z_{\sigma_1} . X(Z) & \tau = \langle\sigma_1,\sigma_2\rangle \\ \qquad\qquad\qquad \sqcap_{\langle\sigma_2,\langle\sigma_2,\sigma_2\rangle\rangle} Y(Z) \end{cases}$$

$$\sqcup_{\langle\tau,\langle\tau,\tau\rangle\rangle} \quad = \begin{cases} \vee_{\langle t,\langle t,t\rangle\rangle} \\ \lambda X_\tau . \lambda Y_\tau . \lambda Z_{\sigma_1} . X(Z) & \tau = \langle\sigma_1,\sigma_2\rangle \\ \qquad\qquad\qquad \sqcup_{\langle\sigma_2,\langle\sigma_2,\sigma_2\rangle\rangle} Y(Z) \end{cases}$$

$$\neg_{\langle\tau,\tau\rangle} \quad = \begin{cases} \neg_{\langle t,t\rangle} \\ \lambda X_\tau . \lambda Z_{\sigma_1} . \neg_{\langle\sigma_2,\sigma_2\rangle}(X(Z)) & \tau = \langle\sigma_1,\sigma_2\rangle \end{cases}$$

$$\sqsubseteq_{\langle\tau,\langle\tau,t\rangle\rangle} \quad = \begin{cases} \rightarrow_{\langle t,\langle t,t\rangle\rangle} \\ \lambda X_\tau . \lambda Y_\tau . \forall Z_{\sigma_1} \begin{bmatrix} X(Z) \\ \sqsubseteq_{\langle\sigma_2,\langle\sigma_2,t\rangle\rangle} Y(Z) \end{bmatrix} & \tau = \langle\sigma_1,\sigma_2\rangle \end{cases}$$

4.4 PLURALITY

In this section, I outline the theory of plurality adopted here, which makes use of the boolean operations defined in the previous two sections.

4.4.1 *Plural individuals*

Following Bennett 1974, Winter 2001 and others, I assume that there is a type-theoretic distinction between atomic individuals and pluralities. Atomic individuals denote members of D_e, whereas pluralities are members of $D_{\langle e,t\rangle}$; they denote (the characteristic function of) a set of atomic individuals.

$(299) \quad [\![\text{Nathan}]\!] = \text{Nathan}$

$\qquad\qquad :: e$

(300)　$[\![\text{Nathan and Josie}]\!] = \begin{cases} \lambda x \,.\, x = \text{Nathan} & \text{function talk} \\ \quad\quad \lor\, x = \text{Josie}(x) \\ \{\text{Nathan, Josie}\} & \text{set talk} \end{cases}$

$$:: \langle e, t \rangle$$

Collective predicates such as *meet* and *gather* are taken to have higher order meanings.

(301)　$[\![\text{meet}]\!] = \lambda w \,.\, \lambda X_{\langle e,t \rangle} \,.\, \text{meet}_w(X)$

This captures the fact that collective predicates[10] such as *meet* require a semantically plural argument as a matter of how the predicates are typed.

(302)

4.4.2　*Pluralization*

Correspondingly, I maintain the assumption that singular NPs range over atomic individuals. Plural NPs, on the other hand, range over pluralities.[11]

10　More accurately, Winter's (2001) *set predicates* (see also Winter 1998, de Vries 2015). Winter argues against the traditional division into *distributive*, *collective*, and *mixed* predicates, and in favour of a dichotomy between *atom* and *set* predicates.

11　Note that the plural NP *boys* does not take a world argument. This is because I assume that the internal composition of *boys* is as in (303), where w_0 is a world pronoun saturating the outer argument of *boy*.

(303)　[PL [w_0 boy]]

(304) $\llbracket \text{boy} \rrbracket = \begin{cases} \lambda w \,.\, \lambda x \,.\, \text{boy}_w(x) & \text{function talk} \\[2mm] \{\text{Jeff}, \text{Abed}, \text{Troy}\} & \text{set talk (in } w_0) \end{cases}$

(305) $\llbracket \text{boys} \rrbracket = \begin{cases} \lambda X : \exists x'[X(x')] \,.\, \forall x \begin{bmatrix} X(x) \\ \to \text{boy}_{w_0}(x) \end{bmatrix} & \text{function talk} \\[4mm] \left\{ \begin{array}{c} \{\text{Jeff}\}, \{\text{Abed}\}, \{\text{Troy}\} \\[1mm] \{\text{Jeff}, \text{Abed}\}, \{\text{Jeff}, \text{Troy}\}, \\[1mm] \{\text{Abed}, \text{Troy}\}, \{\text{Jeff}, \text{Abed}, \text{Troy}\} \end{array} \right\} & \text{set talk} \end{cases}$

I assume that the plural morphology is the exponent of a type-flexible pluralization operator ∗ in the syntax, defined in (306), for any type σ

(306) $\llbracket \ast \rrbracket = \begin{cases} \lambda P_{\langle \sigma, t \rangle} \,.\, \lambda Q_{\langle \sigma, t \rangle} : \exists x_\sigma[Q(x)] & \text{function talk} \\[3mm] \quad\quad\quad .\, \forall x'_\sigma \begin{bmatrix} Q(x') \\ \to P(x) \end{bmatrix} \\[4mm] \mathcal{P}(P) - \varnothing & \text{set talk} \end{cases}$

The internal composition of a plural NP such as *boys* is therefore as in (307).

(307)

∗ serves a second purpose: it allows plurality-denoting expressions to compose with distributive predicates (atom predicates in Winter's typology) such as *sneeze*, which I take to be of type $\langle e, t \rangle$. Ordinarily, this would result in a type mismatch. Composing ∗ with the predicate first lifts it to a higher type, allowing it to compose with a plurality-denoting expression, and correctly predicting distributive inferences.

(308)

$$
\begin{array}{c}
\textbf{✗} \\
\diagup\diagdown \\
\langle e, t \rangle \qquad \langle e, t \rangle \\
\text{the boys}_{w_0} \qquad \text{sneeze}_{w_0}
\end{array}
$$

(309)

$$
\begin{array}{c}
\textbf{✓} \\
\langle e, t \rangle \qquad \langle\langle e, t \rangle, t \rangle \\
\text{the boys}_{w_0} \qquad ∗ \quad \langle e, t \rangle \\
\text{sneeze}_{w_0}
\end{array}
$$
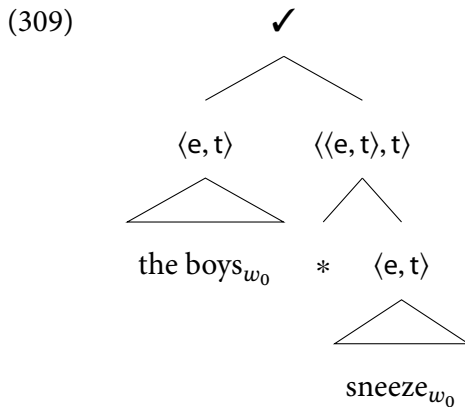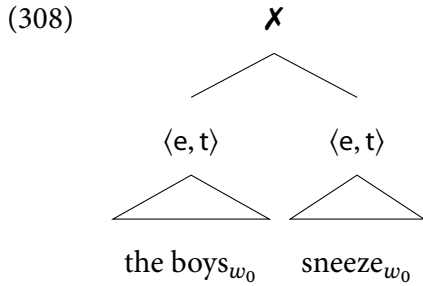
Derivation for (309)[12]

---

12 Following Winter 2001 I assume that the plural definite article the_{pl} denotes the composition of the *maximization* and *iota* operators MAX ∘ ι

(310) $\text{MAX}_{\langle\langle\tau,t\rangle,\langle\tau,t\rangle\rangle} = \lambda P_{\langle\tau,t\rangle} . \lambda x_\tau . P(x) \wedge \forall y \in P[x \sqsubseteq y \rightarrow x = y]$

(311) $\iota_{\langle\langle\sigma,t\rangle,\sigma\rangle} = \lambda P_{\langle\sigma,t\rangle} . x$
           defined if $P = \{x\}$

(313) $[\![\text{the boys}_{w_0}]\!]$

$$= \iota X'[\text{MAX}(\lambda X : \exists x'[X(x')] . \forall x \begin{bmatrix} X(x) \\ \rightarrow \text{boy}_{w_0}(x) \end{bmatrix})(X')]$$

(314) $[\![\text{sneeze}_{w_0}]\!] = \lambda x . \text{sneeze}_{w_0}(x)$

(315) $[\![*]\!]([\![\text{sneeze}_{w_0}]\!]) = \lambda X : \exists x'[X(x')]$

$$. \forall x \begin{bmatrix} X(x) \\ \rightarrow \text{sneeze}_{w_0}(x) \end{bmatrix}$$

(316) $[\![(315)]\!]([\![(313)]\!]) = 1$ iff

$$\forall y \begin{bmatrix} [\iota X'[\text{MAX}(\lambda X : \exists x'[X(x')] . \forall x \begin{bmatrix} X(x) \\ \rightarrow \text{boy}_{w_0}(x) \end{bmatrix})(X')](y) \\ \rightarrow \text{sneeze}_{w_0}(y) \end{bmatrix}$$

Defined if there is a unique maximal plurality of boys

The resulting truth-conditions in (316) state, in more informal terms, that *the boys sneeze* is true iff each boy in the unique maximal plurality of boys sneezed, and is defined if there is a unique maximal plurality of boys.

Following Winter 2001 and de Vries 2015, I assume that $*$ can compose with phrasal nodes, in order to derive phrasal distributivity.

4.5   EVENTS AND PLURALITY

Since events are just members of D_e, they boolean theory of plurality outlined in the previous section integrates straightforwardly with the neo-Davidsonian Logical Forms we have been assuming throughout this thesis. Let's consider the derivation of (317). Intuitively, we would like (317)

---

(312) $[\![\text{the}_{\text{pl}}]\!] = \lambda P_{\langle \tau, t \rangle} . \iota x_\tau[[\text{MAX}(P)](x)]$

In informal terms, what the$_{\text{pl}}$ does is take a set of sets P, and return the unique maximal set x in that set, if there is such an x, and otherwise is undefined. Again, following Winter 2001 I assume that the$_{\text{sg}}$ simply denotes the *iota* operator.

to entail the existence of a plural sneezing event E, where a plurality X consisting of two boys is the joint agent of E, and for each subpart e of E, one of the boys is the agent of e, and for each of the boys x, x is the agent of one of the sneezing events.

(317)   Two boys are sneezing.

We can derive these truth-conditions straightforwardly by applying out plurality operator $*$ to the verb and the argument introducing head. We also need to assume the existence of a *plural* closure operation $*\exists$, which existentially closes a property of plural events.
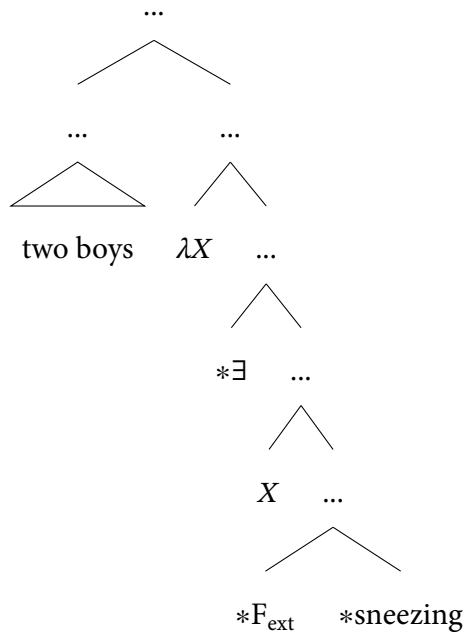
(318) $[\![*\text{sneeze}]\!] = \lambda f : \exists e'[f(e')] . \forall e[f(e) \rightarrow \text{sneeze}(e)]$

(319) $[\![*\text{F}_{\text{ext}}]\!] = \lambda F . \lambda X . \lambda f . \forall x[X(x) \rightarrow \exists e[f(e) \wedge \mathcal{AG}_w(e) = x]]$

$\qquad\qquad\qquad \wedge \forall e[f(e) \rightarrow \exists x[X(x) \wedge \mathcal{AG}_w(e) = x]]$

$\qquad\qquad\qquad \wedge F(f)$

(320) $[\![\text{two boys}]\!] = \lambda Q . \exists X[\text{twoBoys}_w(X) \wedge Q(X)]$

(321) $[\![*\exists]\!] = \lambda F . \exists f[F(f)]$

(322)

$$(323) \quad = 1 \text{ iff } \exists X, f \begin{bmatrix} \text{twoBoys}(X) \\ \land \forall x[X(x) \rightarrow \exists e[f(e) \land \mathcal{AG}_w(e) = x]] \\ \land \forall e[f(e)a \rightarrow \exists x[X(x) \land \mathcal{AG}_w(e) = x]] \\ \land \forall e[f(e) \rightarrow \text{sneezing}_w(e)] \end{bmatrix}$$

Interesting, we can make use of $*$ in concert with VP fronting to account for the example in 324, from Schein 1993: 7. Schein observes that in (324), we have a modifier *in slow progression*, which modifies the entire plurality of striking events, and a distributive quantifier *every organ*, which distributes over the striking events. Schein does not give a compositional analysis of this sentence, and this is, to my knowledge, a novel analysis. I leave further explorations of the boolean theory of plurality and its interactions with neo-Davidsonian event semantics to future work.

(324)   In slow progression, every organ student struck a note on the Wurlitzer.

(325)   a. $[\![\text{in slow progression}]\!] = \lambda f_{\langle v, t \rangle} . \text{slowProgression}(f)$

       b. $[\![a]\!] = \lambda p_{\langle \sigma, t \rangle} . \lambda q_{\langle \sigma, t \rangle} . \exists x_\sigma [p(x) \land q(x)]$ for any type σ

       c. $[\![^*]\!] = \lambda p_{\langle \sigma, t \rangle} . \lambda q_{\langle \sigma, t \rangle} . \forall x_\sigma [q(x) \rightarrow p(x)]$ for any type σ

       d. $[\![\exists]\!] = \lambda p_{\langle \sigma, t \rangle} . \exists x_\sigma [p(x)]$ for any type σ

       e. $[\![^*\text{agent}]\!] = \lambda F_{\langle vt, t \rangle} . \lambda X . \lambda f . \forall x \begin{bmatrix} X(x) \\ \rightarrow \exists e \begin{bmatrix} f(e) \\ \land \text{ag}(e) = x \end{bmatrix} \end{bmatrix}$

$$\land \forall e \begin{bmatrix} f(e) \\ \rightarrow \exists x \begin{bmatrix} X(x) \\ \land \text{ag}(e) = x \end{bmatrix} \end{bmatrix}$$

       f. $[\![\text{lift}]\!] = \lambda a_\sigma . \lambda b_\sigma . b = a$ for any type σ

       g. $[\![\text{every organ student}]\!] = \lambda p . \forall x[\text{organStudent} \rightarrow p(x)]$

       h. $[\![\text{struck a note on the Wurlitzer}]\!] = \lambda e_v . \text{struckANote}(e)$

(326) Unharmoniously, every organ student sustained a note on the Wurlitzer.

(327)

$$\exists f_{vt} \begin{bmatrix} \text{unharmonious}(f) \\ \wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow \text{susANote}(e) \end{bmatrix} \\ \wedge \forall x \begin{bmatrix} \text{student}(x) \\ \rightarrow \exists f_{vt} \forall x \in \{x\}, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix} \\ \wedge \forall e \in f, \exists x \in \{x\} \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix} \\ \wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$\lambda F_{\langle vt,t\rangle} . \exists f_{vt} \begin{bmatrix} \text{unharmonious}(f) \\ \wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow \text{susANote}(e) \end{bmatrix} \\ \wedge F(f) \end{bmatrix}$ ...

a $\lambda f_{vt} . \text{unharmonious}(f) \wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow \text{susANote}(e) \end{bmatrix}$

unharmoniously $\lambda f_{vt} . \forall e \begin{bmatrix} f(e) \\ \rightarrow \text{susANote}(e) \end{bmatrix}$

$\ast$ $\lambda e . \text{susANote}(e)$

sustain a note
on the Wurlitzer

student(x)
$\rightarrow \exists f_{vt} \forall x \in \{x\}, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \in f, \exists x \in \{x\} \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix}$

λf $\forall x$

...   ...

every student λx $\exists f_{vt} \forall x \in \{x\}, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \in f, \exists x \in \{x\} \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix}$

$\exists$ $\lambda f_{vt} . \forall x \in \{x\}, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \in f, \exists x \in \{x\} \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix}$

$\{x\}$ $\lambda X_{et} . \lambda f_{vt} . \forall x \in X, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \in f, \exists x \in X \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix}$

lift x

$\lambda F_{\langle vt,t\rangle} . \lambda X_{et} . \lambda f_{vt} . \forall x \in X, \exists e \in f \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge \forall e \in f, \exists x \in X \begin{bmatrix} \text{ag}(e) \\ = x \end{bmatrix}$
$\wedge F(f)$
agent*

$\lambda f . \forall e \begin{bmatrix} f(e) \\ \rightarrow f'(e) \end{bmatrix}$

$\ast$ $f'_{\langle v,t\rangle}$

4.6 SEMANTICS OF ATTITUDE VERBS

Hintikka (1969) developed a semantic account of attitude verbs still standardly assumed in the linguistic semantic literature. Hintikka's analysis is framed in terms of *possible worlds*.

(328) $D_s = W$, the set of possible worlds

A possible world is a full specified state of affairs. The belief state of an individual x in a world w may leave certain questions open. We can model belief states of individuals using possible worlds.

(329) Doxastic alternatives
$$\text{Dox}_{x,w} = \left\{ \begin{array}{l} w' : \text{it is compatible with what} \\ x \text{ believes in } w \text{ for } w' \text{ to be } w \end{array} \right\}$$

(330) a. w_1: Deckard is an android, Rachael is an android

  b. w_2: Deckard is an android, Rachael is a human

  c. w_3: Deckard is a human, Rachael is an android

  d. w_4: Deckard is a human, Rachael is an human

Imagine that in w_1 Deckard believes that Rachael is an android, but he isn't sure about himself. Then Deckard's doxastic alternatives in w_1 are as follows:

(331) $\text{Dox}_{\text{Deckard},w_1} = \{w_1, w_3\}$

An LF for *belief reports*.

(332)
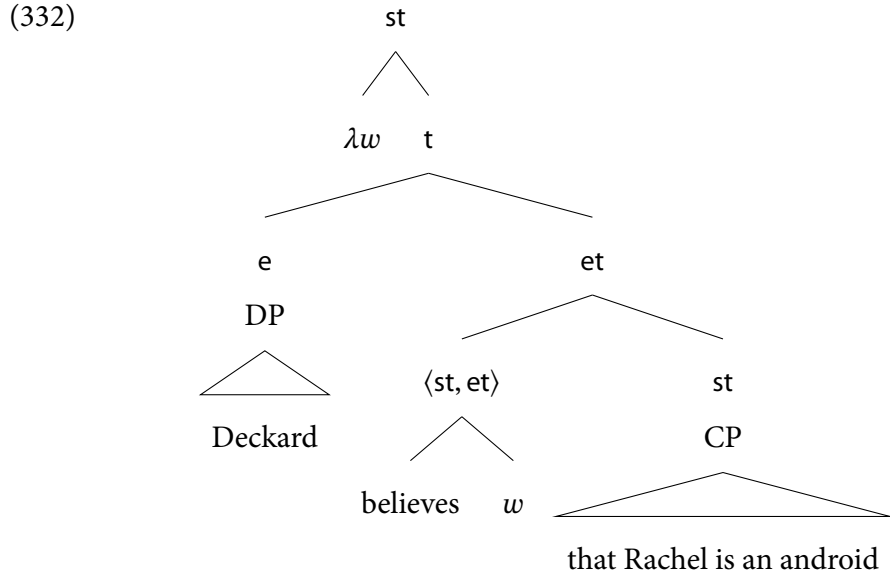
The semantics I assign to *believe* is the *extensional variant* from Pearson 2015: 7.

(333) $[\![\text{believe}]\!] = \lambda w \,.\, \lambda p \,.\, \lambda x \,.\, \forall w' \begin{bmatrix} w' \in \text{Dox}_{x,w} \\ \to p(w') = 1 \end{bmatrix}$

(334) $[\![(332)]\!] = \lambda w \,.\, \forall w'[w' \in \text{Dox}_{\text{Deckard},w} \to \text{android}_{w'}(\text{Rachel})]$

Pearson (2015) and others show how this approach can be extended to communication verbs such as *say* and *claim*.

(335) *Say* alternatives

$\text{Say}_{x,w} = \left\{ \begin{aligned} w' \,:\,\, & \text{it is compatible with what} \\ & x \text{ says in } w \text{ for } w \text{ to be } w' \end{aligned} \right\}$

(336) $[\![\text{say}]\!] = \lambda w \,.\, \lambda p \,.\, \lambda x \,.\, \forall w' \begin{bmatrix} w' \in \text{Say}_{x,w} \\ \to p(w') = 1 \end{bmatrix}$

Note that on the Hintikkan account, *believe* and *say* share a common semantic core. We can capture this via an abstract morpheme ATT.

(337) $[\![\text{believe}]\!] = \lambda x \,.\, \lambda w \,.\, \lambda w' \,.\,$ it is compatible with what

x believes in w for w to be w'

(338) $[\![\text{ATT}]\!] = \lambda R \in D_{\langle e, \langle s, st \rangle \rangle} \,.\, \lambda w \,.\, \lambda p \,.\, \lambda x \,.\, \forall w' [R(x)(w)(w')$

$\rightarrow p(w') = 1]$

(339)

$$
\begin{array}{cccc}
... & & ... & \\
\diagup\,\diagdown & & \diagup\,\diagdown & \\
\text{ATT} & \text{believe} & \text{ATT} & \text{say}
\end{array}
$$

I propose that Hintikkan truth-conditions for attitude verbs can be reconciled with the neo-Davidsonian conjecture in the following way. Note that we have already invoked contextual allosemy rules elsewhere.

(340) $[\![\text{F}_{\text{ext}}]\!] \leftrightarrow \lambda w \,.\, \lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{HOLDER}_w(e) = x$

$$
\forall w' \left[\begin{array}{l} \text{Dox}_{\mathcal{HOLDER}_w(e), w}(w') \\ \rightarrow \mathcal{CONT}_w(e)w' \end{array} \right]
$$

$\wedge f(e)$

$/ \, \underline{}[_v \sqrt{\text{belief}}\,]$

4.7 PLURAL BELIEFS

I assume that at any given point in time, an individual is the holder of a (potentially) a plurality of belief states. I define a function DOXSTATES for an individual to the plurality of their belief states (a member of $D_{\langle e, t \rangle}$).

(341) DOXSTATES$(w)(x) = \lambda e \,.\, \text{belief} \wedge \mathcal{HOLDER}_w(e) = x$

Imagine that we're in a scenario where Yasu believes that Ed is upset, and Laura is angry.

(342)   DOXSTATES(@)(Yasu) = $\{s_E, s_L\}$

(343)   a. $\mathcal{HOLDER}_@(s_E)$ = Yasu

　　　b. $\mathcal{HOLDER}_@(s_L)$ = Yasu

Pluralities of beliefs that Yasu is the holder of:

(344) $\lambda f . \forall s[f(s) \rightarrow \text{DOXSTATES}(@)(\text{Yasu})(s)]$

(345) $\left\{ \begin{array}{c} \{s_E\}, \{s_L\} \\ \{s_E, s_L\} \end{array} \right\}$

$\mathcal{CONT}$ is a homomorphism in every worlds from the plural doxastic states of an individual to their set of beliefs closed under boolean meet.

(346)   ⟦Yasu believes that Ed is upset⟧

$$= \lambda w . \exists s \begin{bmatrix} \mathcal{HOLDER}_w(s) = \text{Yasu} \\ \wedge \text{ belief}_w(s) \\ \wedge \mathcal{CONT}_w(s) = \text{that Ed is upset} \end{bmatrix}$$

(347)   ⟦Yasu believes that Ed is upset⟧

$$= \lambda w . \exists s \begin{bmatrix} \mathcal{HOLDER}_w(s) = \text{Yasu} \\ \wedge \text{ belief}_w(s) \\ \wedge \mathcal{CONT}_w(s) = \text{that Laura is angry} \end{bmatrix}$$

If (346) is true in @, and (347) is true in @, this guarantees, in @ that the following is true:

(348)   ⟦Yasu believes that Ed is upset and Laura is angry⟧

EXTENSIONS

IN THIS HIGHLY SPECULATIVE FINAL CHAPTER, I show how the account of embedded clauses argued for here can be extended to a number of different domains, resulting in superior empirical coverage. In §5.1, I show how the predicative account of *that*-clauses can account for Hartman's (2012) distinction between CP-Subject-Matter and CP-Causer predicates. In §5.2, I show how the predicative account of *that*-clauses integrates with existing account of movement dependencies. In §5.3, I show how to account for cases of non-Boolean coordination of *that*-clauses in subject position.

"To learn which questions are unanswerable, and not to answer them: this skill is most needful in times of stress and darkness."

— The Left Hand of Darkness, Ursula le Guin

5.1 EXPERIENCER VERBS

There is a certain amount of overlap between the empirical focus of the account of clausal embedding, and Hartman 2012. Hartman (building on D. M. Pesetsky 1995) proposes a general division between CP-Subject-Matter (CP-SM) predicates and CP-Causer (CP-C) predicates. The claim is that in (349a), the *that*-clause is the *subject matter* of the verb, and in (349b), the *that*-clause is the *causer* of the verb.[1]

(349) a. Henning worries [$_{CP}$ that Nathan is angry].   CP-SM

　　　 b. [$_{CP}$ That Nathan is angry] worries Henning.   CP-SM

The account of *that*-clauses as content-providing 𝒞Ps immediately accounts for the fact that in (349a), the embedded *that*-clause is interpreted

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1　Hartman is working within a framework in which thematic roles such as *causer* and *subject matter* are syntactic primitives, and does not give a compositional semantics for the sentences in (349).
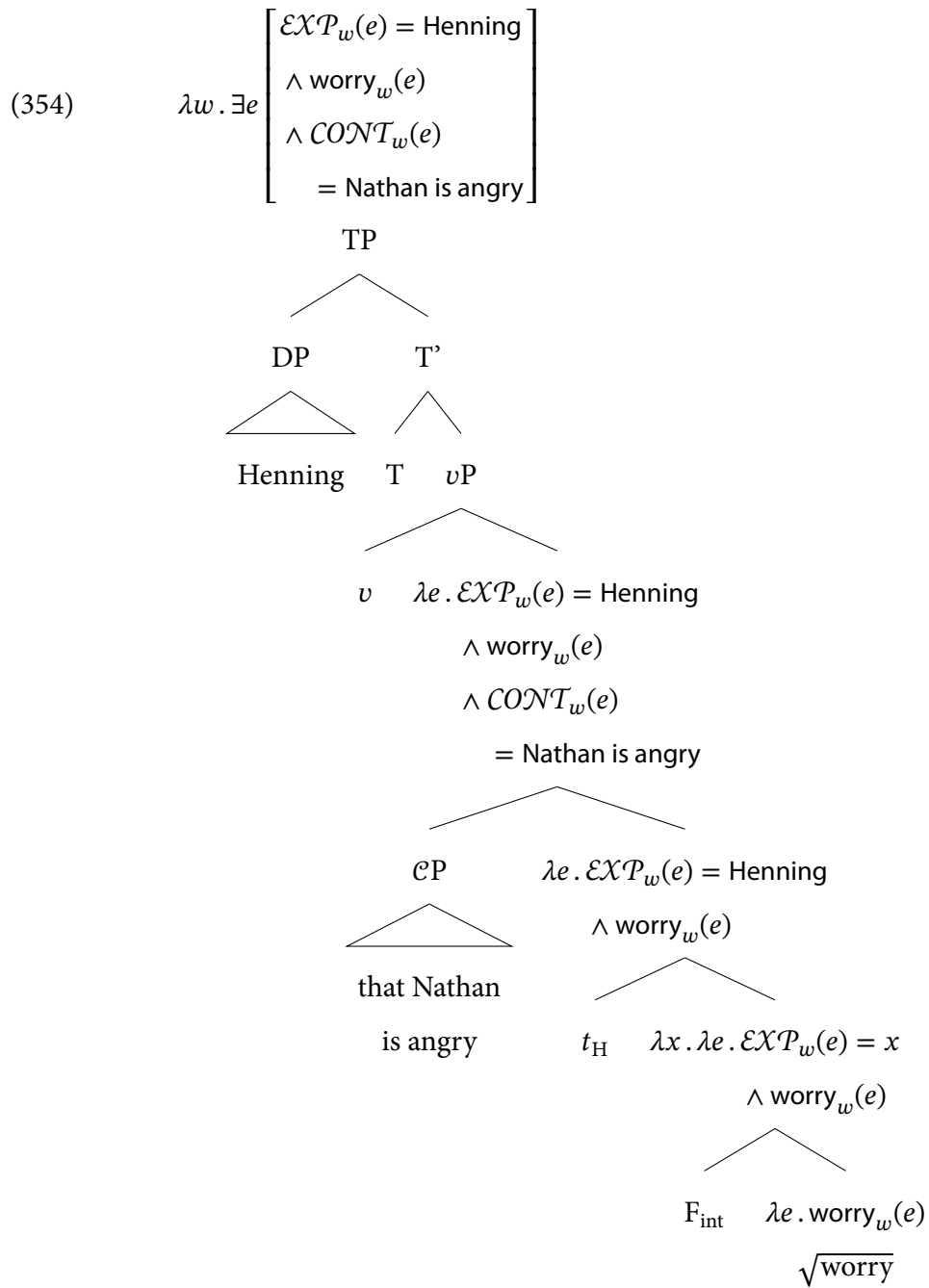
as what Hartman refers to as a *subject matter*. We can therefore eliminate SUBJECT MATTER as a primitive thematic role, at least for clausal arguments. The derivation for a CP-SM sentence should be familiar at this point, and is outlined below.

(350) $\llbracket \sqrt{\text{worry}} \rrbracket = \lambda w \,.\, \lambda e \,.\, \text{worrying}_w(e)$

(351) $\llbracket \text{F}_{\text{int}} \rrbracket \leftrightarrow \lambda w \,.\, \lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{EXP}_w(e) = x \wedge f(e)$
           $/ \underline{\quad} \sqrt{\text{worry}}$

(352) $\llbracket \text{F}_{\text{ext}} \rrbracket \leftrightarrow \lambda w \,.\, \lambda f \,.\, \lambda x \,.\, \lambda e \,.\, \mathcal{CAUSE}_w(e) = x \wedge f(e)$

(353) Henning worries [$_{\text{CP}}$ that Nathan is angry].

(354) $\lambda w \,.\, \exists e \begin{bmatrix} \mathcal{EXP}_w(e) = \text{Henning} \\[4pt] \wedge\, \text{worry}_w(e) \\[4pt] \wedge\, \mathcal{CONT}_w(e) \\[4pt] = \text{Nathan is angry} \end{bmatrix}$

TP

DP   T'

Henning   T vP

v $\lambda e \,.\, \mathcal{EXP}_w(e) = \text{Henning}$
$\wedge\, \text{worry}_w(e)$
$\wedge\, \mathcal{CONT}_w(e)$
$= \text{Nathan is angry}$

$\mathcal{C}$P $\lambda e \,.\, \mathcal{EXP}_w(e) = \text{Henning}$
$\wedge\, \text{worry}_w(e)$

that Nathan

is angry t_{H} $\lambda x \,.\, \lambda e \,.\, \mathcal{EXP}_w(e) = x$
$\wedge\, \text{worry}_w(e)$

F$_{\text{int}}$ $\lambda e \,.\, \text{worry}_w(e)$
$\sqrt{\text{worry}}$

The CP-C cases are potentially more problematic. Prima facie, based on the account outlined thus far, we might expect that all attitude verbs give rise to a CP-SM reading, but this is empirically not the case. In order

to account for the fact that the CP is obligatorily interpreted as a causer in (349b), we can posit the following structure. I would like to claim, generally, that when the *that*-clause is an external argument, it must first compose with a null determiner $\mathcal{D}$, in order to shift its type to type e. If $\mathcal{D}$ is not present in the derivation, then merger of a predicate CP as an external argument leads to a type clash. This claim builds on existing work by e. g., Takahashi (2010) arguing that clauses in subject position are surrounded by a DP layer. Here, the necessity of inserting $\mathcal{D}$ is driven by the needs of the compositional semantics, rather than the syntax.

(355) $\quad \lambda w . \exists e \left[\begin{array}{l} \mathcal{CAUSE}_w(e) = \iota x \left[\begin{array}{l} \mathsf{fact}_w(x) \\ \wedge\, \mathcal{CONT}_w(x) = \mathsf{Nathan\ is\ angry} \end{array} \right] \\ \wedge\, \mathcal{EXP}_w(e) = \mathsf{Henning} \wedge \mathsf{worrying}_w(e) \end{array} \right]$
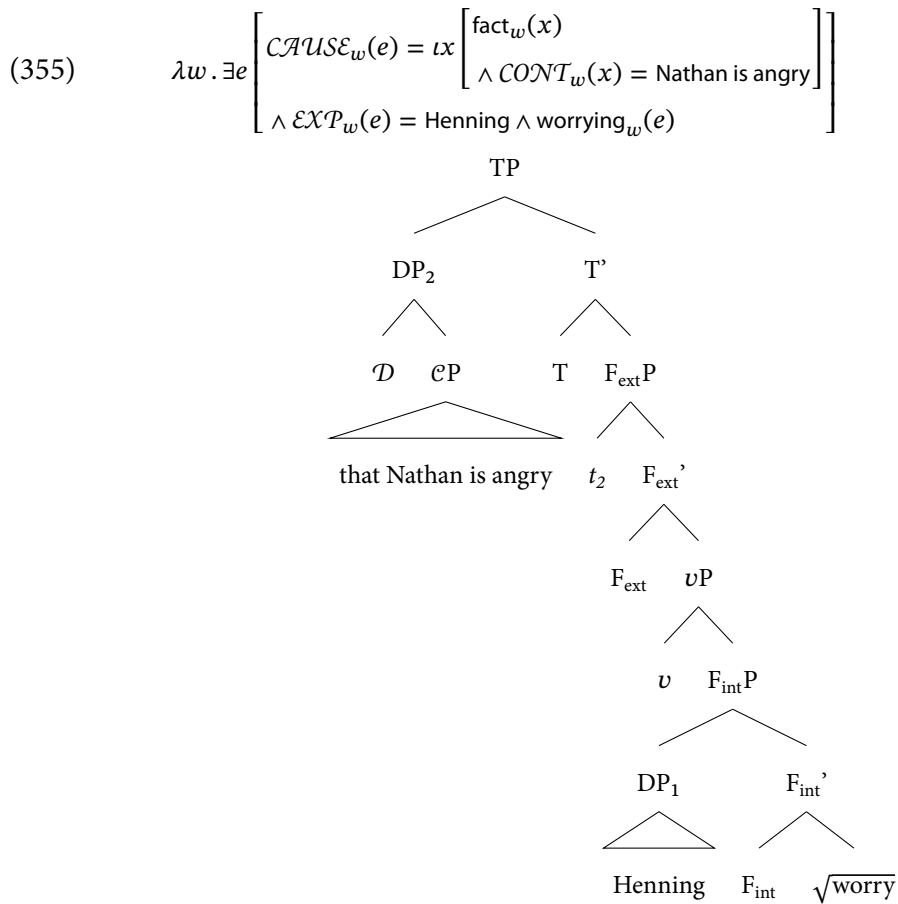
The EPP feature on T probes down for the closest nominal and attracts it to its specifier.

Certain predicates, such as *upset* give rise to a CP-C reading even when the CP is *not* in subject position, such as in (358a).[2]

(358) a. Henning is upset [CP that Nathan left].

   b. [CP That Nathan left] upset Henning.

One way to reconcile these facts with the system outlined here is to decompose acCP-C predicates like *upset* into a complex event structure consisting of a result state and a causal state, that is represented syntactically. Crucially, this event structure is represented syntactically (here I follow Hartman 2012).

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2 Here, I simply take Hartman's (2012)'s claims for granted, without discussing how to diagnose *subject matter* vs. *causation* readings.

It is perhaps worth mentioning that I am somewhat skeptical of the distinction between CP-C and CP-SM predicates. Hartman's evidence for treating the verb *worry* as a CP-SM predicate is based on the following contrast with *be worried*, which Hartman claims is ambiguous between a CP-C and a CP-SM reading (p. 131).

(356) I am worried that Mary's drinking again.

   a. ✓CAUSE reading: Mary's drinking again, and it worries me.

   b. ✓SM reading: I'm concerned about the prospect that Mary's drinking again.

(357) I worry that Mary's drinking again.

   a. ✗CAUSE reading: Mary's drinking again, and it worries me.

   b. ✓SM reading: I'm concerned about the prospect that Mary's drinking again.

Once one shifts to an ontological perspective that allows for *contentful entities*, the distinction looks less grounded. Hartman's SM reading can be paraphrased in terms of a causation reading between a contentful *possibility* and a worrying state. I leave further re-assessment of Hartman's empirical claims to future work.

(359)

$$\lambda e . \mathcal{CONT}_w(e) = \text{Nathan is angry}$$

$$\wedge \exists s \begin{bmatrix} \mathcal{EXP}_w(s) \\ \wedge \text{upset}_w(s) \\ \wedge \text{CAUSE}_w(s) = e \\ \wedge \mathcal{EXP}_w(e) = \mathcal{EXP}_w(s) \end{bmatrix}$$

$\lambda x . \mathcal{CONT}_w(x)$
= Nathan is angry

eP

that Nathan is angry

$$\lambda e . \exists s \begin{bmatrix} \mathcal{EXP}_w(s) \\ \wedge \text{upset}_w(s) \\ \wedge \text{CAUSE}_w(s) = e \\ \wedge \mathcal{EXP}_w(e) = \mathcal{EXP}_w(s) \end{bmatrix}$$

$$\lambda f . \lambda e . \exists s \begin{bmatrix} f(s) \\ \wedge \mathcal{CAUSE}_w(s) = e \end{bmatrix}$$

CAUSE

$\lambda s . \mathcal{EXP}_w(s) = x$
$\wedge \text{upset}_w(s)$

$x \quad \dots$

$F_{\text{int}} \quad \lambda s . \text{upset}_w(s)$

$\sqrt{\text{upset}}$
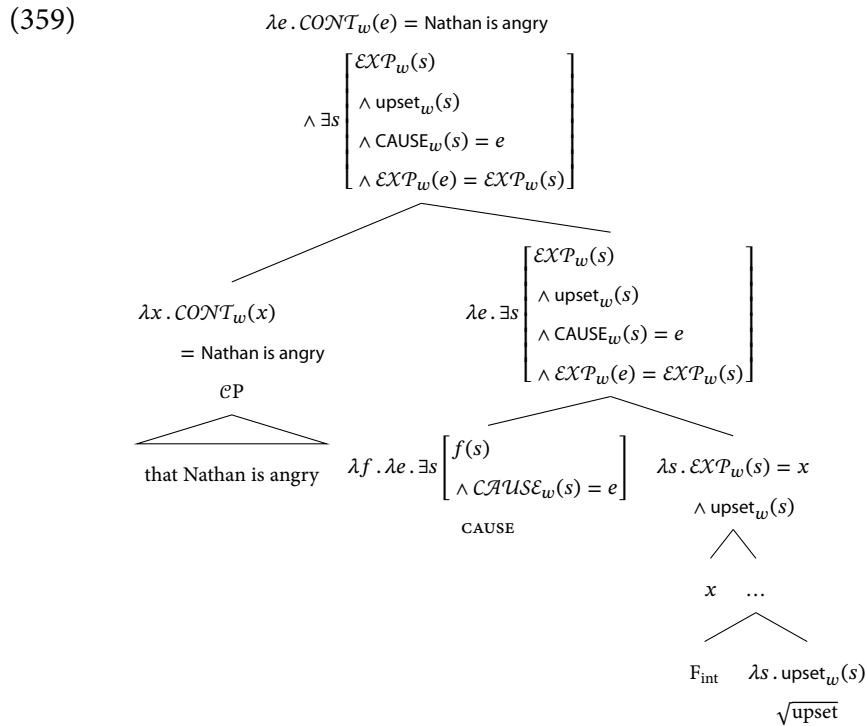
5.1.1 Evidence for $\mathcal{D}$

5.1.1.1 Persian

Hartman (2012) gives cross-linguistic data which shows that $\mathcal{D}$, which is covert in English, surfaces overtly in a variety of different languages. (360-362), from Hartman 2012: p. 36-37 (citing Maziar Toosarvandani p.c.) illustrate this for Persian. When an embedded declarative is in subject position, as in (361), an overt determiner *in* obligatorily surfaces. (360) shows that the same determiner that surfaces in the clausal domain functions as a demonstrative in the nominal domain. (362) shows that in an embedded position, the determiner is obligatorily absent.

(360)   *in   ketab*
        this book

'this book'

(361) { *In* | *⁺ø* } *ke   Maryam raft   ma'alum- e*
       this   that Maryam left.3SG clear-   is

       'That Maryam left is clear'

(362) *Ma'alum- e (*in) ke   Maryam raft*
       clear-   is this   that Maryam left.3SG

       'It is clear that Maryam left is clear'

5.1.1.2   *Russian*

The data in (363-366), from Hartman 2012: p. 37 (citing Liudmila Niko-
laeva, p.c.) illustrate similar facts from Russian. (364) shows that when
an embedded declarative occurs in subject position, an overt determiner
to obligatorily surfaces. (363) shows that *to* is a determiner in the nomi-
nal domain. (365) and (366) show that clausal complements with *to* are
"strongly degraded" (the judgement reported by Hartman).

(363) *to   okno*
       that.N.3SG   window

       'that window'

(364) { *To* | *⁺ø* } *čto Daša ušla   izvestno vsem.*
       that.N.SG that Dasha left.F.3SG known.N everyone.DAT

       'That Dasha left is known to everyone.'

(365) *Vsem   izvestno (??to)   čto Daša ušla.*
       everyone.DAT known.N that.N.SG that Dasha left.F.3SG

       'Everyone knows that Dasha left.'

(366)   *Vse   znajut   (??to)   čto   Daša   ušla.*
        everyone.NOM know.3PM   that.N.SG   that Dasha left.f.3SG

        'Everyone knows that Dasha left.'

5.1.1.3   *Greek*

As reported by Hartman (2012: p. 38), Roussou (1991) shows that, when
an embedded declarative occurs in subject position, as in (368), the de-
terminer *to* obligatorily surfaces. In certain embedded environments, as
in (369), *to* is disallowed - Hartman notes that the distribution of *to*, as
reported by Roussou is complex, but what is important for our purposes
is that *to* is obligatory for clausal subjects.

(367)   *to   vivlio*
        the.NOM   book

        'the book'

(368)   { *To* | **ø* } *oti   lei   psemata apodhiknii tin   enohi tis.*
        the   that tell.3SG lies-ACC prove.3SG the.ACC   guilt her"

        'That she tells lies proves her guilt.'

(369)   *Ksero   (*to) oti   efighe.*
        know.1SG   the   that left.3SG

        'I know that he left.'

5.1.1.4   *Uyghur*

Uyghur (as reported by Hartman 2012) has two embedding strategies:
nominalisation, as in (371), which Hartman takes to be indicative of a
DP shell, and bare clausal embedding, as illustrated in (370). While both
embedding strategies are possible in a non-subject position, as illustrated

by (370) and (371), only nominalised clauses are permitted in subject position, as illustrated by the contrast between (372) and (373).

(370) *Men   Ajgül ket- t-   i   dep   bilimen.*
       I   [Aygül leave- PST- 3.SG C   CP] know.1SG

       'I know that Aygül left.'

(371) *Men   Ajgül-niŋ   ket-ken-   liq   -i-ni*
       I   [[Aygül-GEN leave-ASP- C   CP] DP] -3SG.POSS-ACC
       bilimen.
       know.1SG

       'I know that Aygül left.'

(372) * *Ajgül ket- t-   i   dep   muhim*
       [Aygül leave- pst- 3SG C   CP] important

       'That Aygül left is important.'

(373)   *Ajgül-niŋ   liq   -i*
       [[Aygül-GEN ket-ken-[leave-ASP- C   CP] DP] -3SG.POSS
       muhim.
       important

       'That Aygül left is important.'

5.1.2   *The semantics of D*

5.1.2.1   *Takahashi's (2010) proposal*

Takahashi (2010) claims that DP-shelled clauses denote *maximal plural worlds*. Takahashi assumes that D takes as its argument a proposition of type $\langle s, t \rangle$. Note that, following assumptions made about the semantics of plurality elsewhere in this thesis, I model pluralities as sets. Takahashi assumes the entry for attitude verbs in (374). p is the argument

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saturated by the plural world denoted a DP-shelled clause. Takahashi assumes that plural expressions denote *i-sums*, but once we make the shift to a Bennett-style typing system for plural expressions the parallel between Takahashi's entry and the standard Hintikkan entry becomes apparent – (374) is identical to the standard entry. Furthermore, given that set-theoretic and mereological approaches to plurality can be considered to be isomorphic, Takahashi's entry is equivalent to the standard entry.

(374) $[\![\text{believe}]\!] = \lambda w_s \,.\, \lambda p_{\langle s,t \rangle} \,.\, \lambda x_e \,.\, \forall w' \in \text{Dox}(x)(w) : w' \in p$

The maximal set of worlds at which a proposition is true is simply the set corresponding to the proposition itself. Since Takahashi adopts a standard Link-style typing system for plurals, according to which plural expressions have the same type as singular expressions, $\mathcal{D}$ shifts the type of the proposition it composes with. Once we shift perspective and adopt a set-theoretic approach to plurality, however, it becomes obvious that Takahashi's semantics for $\mathcal{D}$ renders it semantically vacuous.[3]

5.1.2.2   *A simple semantics for $\mathcal{D}$*

One straightforward advantage of the conjecture that embedded declaratives come to denote predicates of type $\langle e, t \rangle$, is that, when it comes to the semantics of $\mathcal{D}$, we can simply adopt, as a null hypothesis, the claim that $\mathcal{D}$ simply means the same thing as the definite determiner *the* in the nominal domain, since both $\mathcal{D}$ and *the* compose with arguments of the same type. Of course, extant work on the semantics of the semantics of the definite determiner *the* could fill entire volumes (see, e.g., Elbourne 2013 for an overview). For our purposes, it will largely suffice to assume that *the* (and, by extension, $\mathcal{D}$) is interpreted as the iota operator (Partee 1986) the iota operator is a partial function which is defined for a set P iff

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3 More precisely, this is because the composition of the pluralisation function $[\![^{\star}]\!]$ and MAX is just the identity function (defined only for sets). This is because $[\![^{\star}]\!]$ takes a set P, and returns its powerset (minus $\varnothing$). MAX takes a set and returns its maximal element, which will always be identical to the input set.

P has a single member, and returns that member. The semantics of the definite determiner is given in terms of the iota operator below:

(375) $[\![\text{the}]\!] = [\![\mathcal{D}]\!] = \lambda P_{\langle\sigma,t\rangle} . \iota x_\sigma[P(x)]$ for any type σ

Although this isn't directly captured by the entry in (375), we also expect $\mathcal{D}$Ps to share other properties with DPs. From a dynamic perspective, we expect $\mathcal{D}$Ps to be anaphoric on an existing discourse referent, much like definite descriptions more generally (Kamp 1981, Heim 1982).

Related to this point, Moulton (2017) points out that an advantage of adopting a predicative denotation for embedded declaratives is that $\mathcal{D}$Ps are predicted to be capable of referring to individuals with propositional content, and furthermore are not necessarily factive – this is because *facts* are not the only individuals with propositional content, there are also *rumours*, *stories*, *theories*, etc., the content of which does not necessarily have to be true. In order to illustrate that $\mathcal{D}$Ps in subject position are not necessarily factive, Moulton (2017: p. 296) gives the example in (376), citing P. Pappas (p.c.).

(376)   *To oti ine   plusios   ine psema*
          [the that is.3SG rich   ] is   lie

          'That he is rich is a lie'

In English, sentential subjects are not necessarily factive, but presuppose the existence of a salient individual with propositional content.

(377)   a.   I heard that Warren is rich.

        b.   Are you kidding?! That Warren is rich is a well known lie.

5.2   INTERPRETATION OF MOVEMENT DEPENDENCIES

In this section I elaborate on the interpretation of moved CPs, sketching how to integrate the theory of CP meanings assumed here with an elegant

account of trace conversion. Recall that rather than simply members of $\mathbb{N}$, indices are taken to be complex – ordered pairs of members of $\mathbb{N}$ and Type. This allows us to give the type-flexible formulation of PA in (378).

(378)　For any assignment g, any index $\langle n, \sigma \rangle \in \mathbb{N} \times \mathsf{Type}$ (where Type is the set of types).

$$\left[\!\!\left[\begin{array}{c} \wedge \\ \langle n,\sigma \rangle \quad \alpha \end{array} \right]\!\!\right]^{g} = \lambda x \in D_{\sigma} . [\![\alpha]\!]^{g[[\langle n,\sigma \rangle \to x]]}$$

For some variable $x \in D_{\sigma}$

I assume the denotation in (380) for an indexed type-flexible definite determiner (after Uli Sauerland 2004). Note that the denotation in (380) is presuppositional.[4] The determiner carries a complex index consisting of a number n and a type σ. It composes with a predicate P ranging over elements in D_{σ}. It returns whatever the assignment function g maps the complex index to, and crucially is defined iff the output of g for the complex index is true of P. In order for presuppositions to project, we must slightly modify the definition of FA, introducing definedness conditions on its application. (379a) simply says that a complex structure consisting of sisters α and β inherits the definedness conditions α and β.

(379)　Functional Application (for presupposition projection)

　　a.

$$\begin{array}{c} \wedge \\ \alpha \quad \beta \end{array} \in \mathrm{dom}([\![.]\!]^{g}) \text{ iff } \alpha \in \mathrm{dom}([\![.]\!]^{g}) \\ \wedge \beta \in \mathrm{dom}([\![.]\!]^{g}) \\ \wedge [\![\beta]\!]^{g} \in \mathrm{dom}([\![\alpha]\!]^{g})$$

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4 For the purposes of exposition, I model presuppositions as definedness conditions on partial functions, following Heim & Kratzer 1998.

b.

$$\left[\!\left[\begin{array}{c} \wedge \\ \alpha \quad \beta \end{array} \right]\!\right]^{g} = [\![\alpha]\!]([\![\beta]\!])$$

(380)   For any assignment g, any index $\langle n, \sigma \rangle \in \mathbb{N} \times \mathsf{Type}$

$[\![\mathrm{the}_{\langle n,\sigma \rangle}]\!]^{g} = \lambda P \in D_{\langle \sigma, t \rangle} : P(g(\langle n, \sigma \rangle)) = 1 \,.\, g(\langle n, \sigma \rangle)$
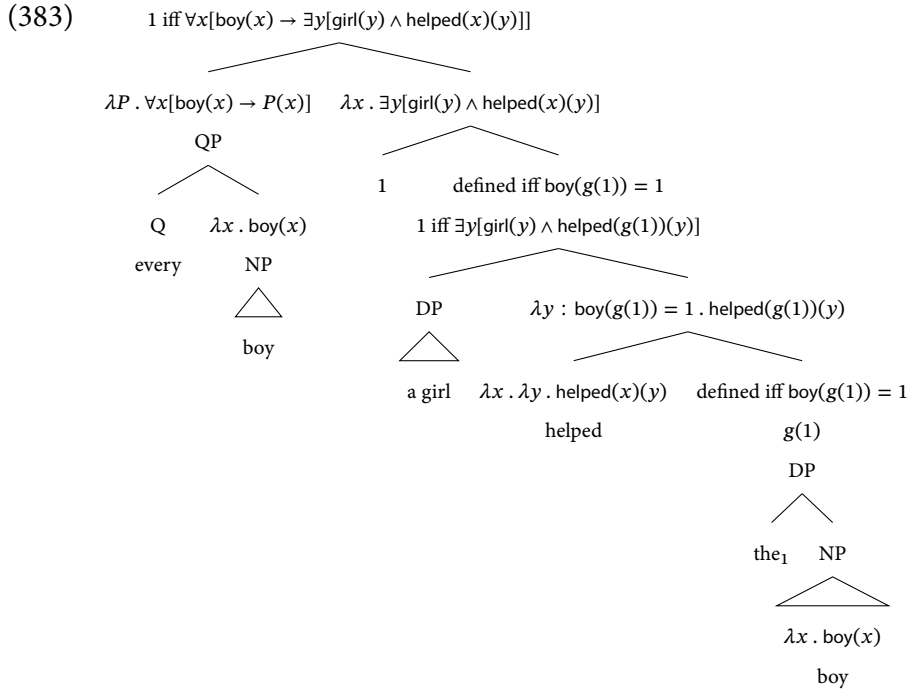
(381)   Functional Application (for presupposition projection)

a.

$\begin{array}{c} \wedge \\ \alpha \quad \beta \end{array}$ $\in \mathrm{dom}([\![.]\!]^{g})$ iff $\alpha \in \mathrm{dom}([\![.]\!]^{g})$

$\wedge\, \beta \in \mathrm{dom}([\![.]\!]^{g})$

$\wedge\, [\![\beta]\!]^{g} \in \mathrm{dom}([\![\alpha]\!]^{g})$

b.

$$\left[\!\left[\begin{array}{c} \wedge \\ \alpha \quad \beta \end{array} \right]\!\right]^{g} = [\![\alpha]\!]^{g}([\![\beta]\!]^{g})$$

I adopt a system for interpreting movement chains based primarily on Johnson's (2012) syntax for quantifier raising (see also Fox & Johnson 2016). The basic idea is as follows: quantificational DPs such as *every boy* are really just exponents of (indexed) definite descriptions. The exponence of *the$_n$ boy* as *every boy* is determined by a universal quantifier first-merged at its scope position. The NP part of the indexed definite description in the base position moves and composes with the quantificational head, acting as its restrictor. Johnson's syntax and semantics for QR is illustrated in the following example:

(382)   A girl helped every boy.   *every boy > a girl*
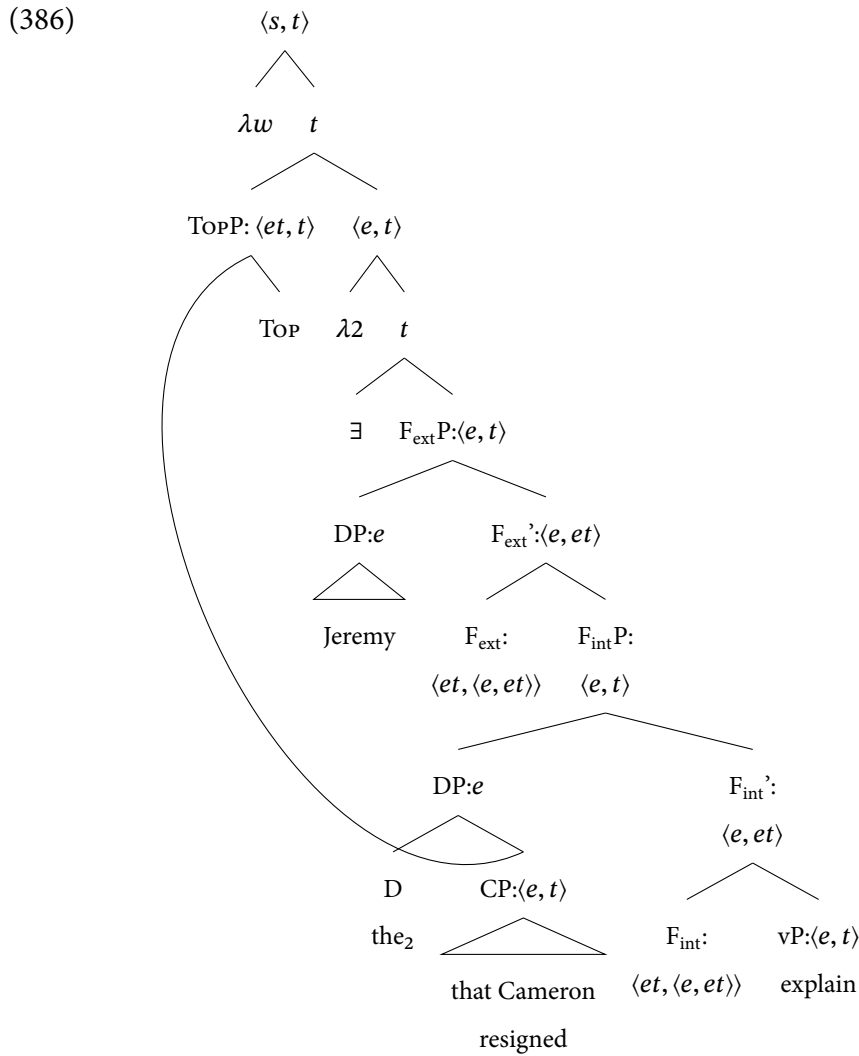
(383)

$1 \text{ iff } \forall x[\text{boy}(x) \to \exists y[\text{girl}(y) \land \text{helped}(x)(y)]]$

$\lambda P . \forall x[\text{boy}(x) \to P(x)]$ $\lambda x . \exists y[\text{girl}(y) \land \text{helped}(x)(y)]$

QP

Q $\lambda x . \text{boy}(x)$ 1 $\text{defined iff boy}(g(1)) = 1$

every   NP $1 \text{ iff } \exists y[\text{girl}(y) \land \text{helped}(g(1))(y)]$

boy   DP $\lambda y : \text{boy}(g(1)) = 1 . \text{helped}(g(1))(y)$

a girl $\lambda x . \lambda y . \text{helped}(x)(y)$ $\text{defined iff boy}(g(1)) = 1$

helped $g(1)$

DP

the_1 NP

$\lambda x . \text{boy}(x)$

boy

Fox & Johnson's (2016) syntactic rule for QR is given in (384).

(384)   QR

Let α be the restrictor of D, and β be the restrictor of Q. If D is the exponent of Q then β reflexively dominates α and if β reflexively dominates α then D is the exponent of Q.   (Fox & Johnson 2016: p. 6)

Note that, this account of how movement chains are interpreted entails that the base position of the CP will be interpreted as type e. It follows that the CP, when moved, must be integrated in the specifier of an argument introducing head, since it can no longer compose with the verb via PM. The straightforward prediction then, for *explain* is that, with CP topicalisation, we should get an *explanandum* reading. I claim that this is exactly what we find. The example below can be paraphrased as follows:

the salient fact/claim etc. is that Cameron resigned, and Jeremy gave an explanation for it.

(385)   That Cameron resigned, Jeremy explained.

(386)

$\langle s, t \rangle$

λw t

TopP: $\langle et, t \rangle$ $\langle e, t \rangle$

Top $\lambda 2$ t

∃ $F_{ext}P:\langle e, t \rangle$

DP:e $F_{ext}':\langle e, et \rangle$

Jeremy $F_{ext}:$ $F_{int}P:$

$\langle et, \langle e, et \rangle \rangle$ $\langle e, t \rangle$

DP:e $F_{int}':$

$\langle e, et \rangle$

D   CP:$\langle e, t \rangle$ $F_{int}:$ vP:$\langle e, t \rangle$

the$_2$ $\langle et, \langle e, et \rangle \rangle$ explain

that Cameron

resigned

Existing work on moving clauses has converged on the generalisation in (387). The account of moving clauses we have outlined here suggests a similar generalization, but framed instead in terms of semantic type. What we expect is that an embedded declarative may only be displaced if the base-generated position is one in which an expression of type e is

allowed to appear. I show here, based on *think*-type verbs, that the generalization framed in terms of semantic type makes superior predictions.

(387)   THE MOVED CLAUSAL COMPLEMENT GENERALIZATION
A clausal complement is allowed to move only if its base-generated position is one in which a DP is allowed to appear. (Takahashi 2010: 345)

(388)   FACT: Passivization of a *that*-clause is degraded with *think*-class predicates, i.e., those that may embed PROPDPs but not CONTDPs.

(389)   That John was a fraud was widely $\begin{Bmatrix} \text{believed,} \\ \text{*thought} \end{Bmatrix}$ by critics of his work.

Think-class verbs are an exception to the generalization in (387). As we have already seen, examples such as (390) show that *think*-class verbs may embed DPs after all, despite being incompatible with CONTDPs. (391) shows that *think*-class verbs may in principle be passivized with an expletive subject.

(390)   Mary thought that John was a fraud, and his own brother thought the same thing.

(391)   It is often thought that John is a fraud.

These facts are exactly what we expect if the base position of the moved CP must be able to host a type e expression. We can account for the selectional restrictions of *think*-type predicates if we simply say that they are incompatible with F_{int}. It follows that both *that*-clauses and PROPDPs can compose with a *think*-type predicate via PM. Once a *that*-clause is moved however, its lower copy is type-shifted via trace-conversion to an expression of e. Since *think*-type predicates do not take internal arguments, there is simply no way to integrate the lower copy into the semantic composition.

Here I show that the assumptions we have made about the semantics of *that*-clauses, along with the system we have assumed for interpreting plural expressions, allows for a novel account of non-Boolean coordination of *that*-clauses.

In a short squib, McCloskey (1991) shows that conjoined clausal subjects may trigger plural agreement. The examples in (392) are taken from McCloskey 1991: p. 564.

(392)   a.   [$_{CP}$ That the president will be reelected]
             and [$_{CP}$ that he will be impeached] are equally likely at this point.

        b.   [$_{CP}$ That the march should go ahead]
             and [$_{CP}$ that it should be cancelled] have been argued by the same people at different times.

        c.   [$_{CP}$ That he'll resign] and [$_{CP}$ that he'll stay in office]
             seem at this point equally possible.

McCloskey claims that whether or not conjoined clausal subjects may trigger plural agreement is governed by semantic factors: "[...]plural agreement is possible just in case the conjoined propositions are contradictory of incompatible, or, more generally, when they specify a plurality of distinct states of affairs or situation-types. When the coordinated clauses denote compatible propositions (that is, when they denote two or more propositions that jointly specify a single complex state of affairs or situation-type), then singular agreement is preferred or required." (p. 564-565). In order to illustrate this requirement, McCloskey gives, e.g., the contrast in (393) (p. 565).

(393)   [$_{CP}$ That UNO will be elected] and [$_{CP}$ that sanctions will be lifted]
        {is | ??are} now likely.

Elliott & Nicolae (2017) observe present contrasts such as (394), to show that distributive readings are dependent on the presence of morphosyntactic plural agreement.

(394) a. [&P [CP Which student gets highest in Math] and [CP which gets highest in Chemistry]] depends on at least two factors.

     b. [&P [CP Which student gets highest in Math] and [CP which in Chemistry]] depend on at least two factors.

(395)

We can show the same thing with *that*-clauses. Note crucially that plural agreement on the predicate feeds the distributive reading.

(396) a. [&P [CP That John was a fraud] and [CP that his wife hated him]] was widely reported by at least two pundits.

     b. [&P [CP That John was a fraud] and [CP that his wife hated him]] were widely reported by at least two pundits.

5.3.1 *Analysis*

In this section, I show how the distributive reading of (397) (repeated from (396b)) follows from the conjecture that *that*-clauses denote predicates of individuals, plus independently motivated logical apparatus for interpreting plural-denoting expressions.

(397) [$_{\&P}$ [$_{CP}$ That John was a fraud] and [$_{CP}$ that his wife hated him]] were widely reported by at least two pundits.

The LF I assume for the sentence in (397) is given in (398).

(398)

For the sake of exposition, I assume that conjunction is English is ambiguous between a type-flexible boolean entry (Partee & Rooth 2012),

and the type-flexible non-boolean entry in (399).[56] The entry in (399) takes two set-denoting arguments and returns their union.

(399) $[\![\text{and}]\!] = \lambda X_{\langle\sigma,t\rangle} . \lambda Y_{\langle\sigma,t\rangle} . \begin{cases} \lambda x_\sigma . X(x) \vee Y(x) & \text{function talk} \\ X \cup Y & \text{set talk} \end{cases}$

The $*$ operator in (400) takes a set-denoting argument and returns its powerset minus the empty set.

(400) $[\![*]\!] = \lambda P_{\langle\sigma,t\rangle} . \lambda Q_{\langle\sigma,t\rangle} : \exists x_\sigma[Q(x)] . \forall x'_\sigma[Q(x') \to P(x')]$

(401) $[\![\text{VP}]\!] = \lambda x_e . \text{reportedByTwoPundits}(x)$

(402) a. $[\![\text{CP}_1]\!] = \lambda x . \mathcal{CONT}_w(x) = \text{J was a fraud}$

  b. $[\![\text{CP}_2]\!] = \lambda x . \mathcal{CONT}_w(x) = \text{J's wife hated J}$

(403) $[\![\text{D}]\!] = \lambda P . \iota x[P(x)]$

(404) $[\![\textsc{ident}]\!] = \lambda a . \lambda b . b = a$

(405) a. $[\![*]\!]([\![\text{VP}]\!]) = \lambda X_{\langle e,t\rangle} : \exists x[X(x)]$

$. \forall x' \begin{bmatrix} X(x') \\ \to \text{reportedByTwoPundits}(x') \end{bmatrix}$

  b. $[\![\textsc{ident}]\!]([\![\text{D}]\!]([\![\text{CP}_1]\!])) = [\lambda x . x = \iota x' \begin{bmatrix} \mathcal{CONT}_w(x') \\ = \text{J was a fraud} \end{bmatrix}]$

  c. $[\![\textsc{ident}]\!]([\![\text{D}]\!]([\![\text{CP}_2]\!])) = [\lambda x . x = \iota x' \begin{bmatrix} \mathcal{CONT}_w(x') \\ = \text{J's wife hated J} \end{bmatrix}]$

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5 The entry in (399) is essentially a type-flexible version of Link's 1983a denotation for non-boolean *and* in the context of a Bennett-style typing system for pluralities.

6 Winter (2001) and Champollion (2016) argue that the non-boolean entry in (399) is in fact derivation of the boolean entry, via the application of additional, independently motivated type-shifters.

d. $\llbracket\text{and}\rrbracket(\llbracket(405\text{c})\rrbracket)(\llbracket(405\text{b})\rrbracket) = \lambda x \,.\, (x = \iota x' \begin{bmatrix} \mathcal{CONT}_w(x') \\ = \text{J was a fraud} \end{bmatrix})$

$\vee\, (x = \iota x'' \begin{bmatrix} \mathcal{CONT}_w(x'') \\ = \text{J's wife hated J} \end{bmatrix})$

e. $\llbracket(405\text{a})\rrbracket(\llbracket(405\text{d})\rrbracket) = 1$ iff $\forall x[((x = \iota x' \begin{bmatrix} \mathcal{CONT}_w(x') \\ = \text{J was a fraud} \end{bmatrix})$

$\vee\, (x = \iota x'' \begin{bmatrix} \mathcal{CONT}_w(x'') \\ = \text{J's wife hated J} \end{bmatrix}))$

$\rightarrow \text{reportedByTwoPundits}(x)]$

CONCLUSION

In this thesis, I have sketched a new account of clausal embedding at the syntax-semantics interface. Here I'd like to lay out some interesting consequences the system developed here has for the theory of *selection*, and broader issues this reveals with neo-Davidsonianism and Distributed Morphology.

One consequence of the system developed here is that certain selectional restrictions traditionally analyzed in terms of narrowly syntactic properties, such as c-selection (Grimshaw 1979) or abstract case (D. M. Pesetsky 1982) should instead be analyzed as a reflex of argument-structural properties. Recall that verbs such as *say* tolerate PROPDP complements and may compose with *that*-clauses, but do not tolerate CONTDP complements.

(406) a. Nathan said [_{DP} something].

b. Nathan said [_{CP} that Henning is upset].

c. *Nathan said [_{DP} the rumour that Henning is upset].

The most straightforward way of capturing this fact is to state that *say* does not take an internal argument. What does it mean, however, for a predicate not to take an internal argument in the neo-Davidsonian framework we have advanced here? We can cash this out by saying that the root in question is incompatible with F_{int}, but how do we state this constraint? The difficulty of stating constraints on argument structure is a more general issue for frameworks in which all arguments are severed. Some authors (see, e. g., Borer 2005 and Lohndal 2014) consider this to be an advantage, due to the fact that certain roots seem to be extremely

flexible in the variety of arguments they may combine with.[1] I however side with authors (see, e. g. G. Ramchand 2005) – we should not give up the idea that roots place no restrictions on which arguments may be introduced at future stages in the derivation, as it is simply not the case that anything goes.

Encyclopaedia in DM are extremely powerful, and contextual allosemy provides one way of connecting constraints on argument structure to the root. We could simply stipulate, for example, that F_{int} has no realization at LF in the context of $\sqrt{say}$. This does not seem very insightful however. Furthermore, this kind of account is problematic in and of itself, since the logic of allowing for conditionalized encyclopaedia entries suggests that there should always be an *elsewhere* case.

Alternatively, one could consider the possibility that argument structure itself is a matter of syntactic selection – F_{int}, after all, takes the $\sqrt{P}$ it combines with as its complement. In this way, it would be possible to impose selectional restrictions on the roots that F_{int} may combine with. This approach seems a little more promising, although it does require us to give up the idea that properties of individual roots are invisible to the syntactic computation, although it has been argued that this is necessary anyway (see, e. g., Harley 2014).

Finally, it is worth mentioning that there is still a great deal of work to be done in terms of integrating a predicative account of *that*-clauses with work on phenomena such as sequence of tense, and the *de se*, which tends to assume something like the traditional Hintikkan account of attitude

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1 In order to illustrate this, consider, e. g., Borer's (2005) well-known example of $\sqrt{siren}$, which can appear in a bewildering array of constructions.

(407) a. The factory horns sirened throughout the raid.

b. The factory horns sirened midday and everyone broke for lunch.

c. The police car sirened the Porsche to stop.

d. The police car sirened up to the accident site.

e. The police car sirened the daylight out of me.

verbs. There is also an intriguing overlap with the conclusions reached here, and early work on the semantics of infinitives (see, e. g., Chierchia 1984), where it has been argued that infinitives denote *properties*. I plan to address these issues in future work on this topic.

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