COMPARING ALTERNATIVES

By

ANG LI

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ABSTRACT OF THE DISSERTATION

Comparing Alternatives

by ANG LI

Dissertation Director: Simon Charlow

I present a new analysis of the meaning of comparatives. While many semanticists who study gradation in natural language employ degrees to analyze comparatives, I contend that comparatives fundamentally involve the comparison of two structurally derived alternatives along a given measurement dimension, rather than an ordering relation directly imposed on two degrees.

The motivation for this new analysis comes from the context dependency of comparatives that lack an overt standard phrase/clause. While the traditional approach predicts that this dependency is no different from degree anaphora, I present evidence to suggest that these incomplete comparatives are actually sensitive to a broader linguistic context that the intended antecedent degree is contained in. The empirical pattern automatically follows if there is an additional requirement, namely that the antecedent degree is the measurement of the alternative we make the comparison to.

This alternative-based meaning turns out to be the key to unlocking a unified account of incomplete comparatives that brings together a class of phenomena, which have led to wildly different comparative meanings in existing proposals. In addition to the infelicity condition in discourse anaphoric comparatives, the alternative-based meaning can also provide a compositional account of the recurrent ambiguities between comparison, additivity, and continuation across languages, as well as the so-called *internal reading*.

For explicit comparative constructions, the alternative-based new analysis challenges a long-held assumption in the literature that the comparative marker takes the *than*-clause as its internal argument, similar to a transitive construction. In my theory, this transitive relation is replaced by an anaphoric binding between the comparative marker and the semantic objects introduced in the *than*-clause. By treating explicit comparatives as intrasentential anaphora, I demonstrate that the theory can handle all kinds of comparative constructions while offering new and superior solutions to some long-standing problems in comparative semantics.

Throughout this dissertation, I aim to show that the new analysis provides better empirical coverage for each of phenomenon under discussion. More importantly, I make the case for a uniform approach: by conceptualizing comparatives as a comparison of alternatives, we gain insight into how seemingly disparate phenomena share a common core and how differences arise from the process of identifying the appropriate alternative for comparison.

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CONTENTS

**Abstract** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ii

**Acknowledgments** . . . . . . . . . . . . . . . . . . . . . . . . . . . . iv

**List of Figures** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . x

**Chapter 1: Introduction** . . . . . . . . . . . . . . . . . . . . . . . . . 1

1.1 Overview . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1

1.2 Comparing alternatives . . . . . . . . . . . . . . . . . . . . . 3

1.3 Building the theory . . . . . . . . . . . . . . . . . . . . . . . 7

1.3.1 Discourse anaphoric comparatives . . . . . . . . . . . . . . . 7

1.3.2 Explicit comparatives . . . . . . . . . . . . . . . . . . . . . 8

1.3.3 Comparative ambiguities . . . . . . . . . . . . . . . . . . . . 9

1.3.4 The internal reading . . . . . . . . . . . . . . . . . . . . . 11

**Chapter 2: Discourse anaphora in comparison** . . . . . . . . . . . . . . 13

2.1 Introduction . . . . . . . . . . . . . . . . . . . . . . . . . . 13

2.2 Data . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14

2.2.1 The null hypothesis for anaphoric comparatives . . . . . . . . 14

2.2.2 Anaphoric amount comparatives . . . . . . . . . . . . . . . . 16

2.2.3 Summary and discussion . . . . . . . . . . . . . . . . . . . . . 19

2.3 Comparison between correlates . . . . . . . . . . . . . . . . . . . . . 22

2.3.1 The direct analysis . . . . . . . . . . . . . . . . . . . . . . 22

2.3.2 Proposal . . . . . . . . . . . . . . . . . . . . . . . . . . . 24

2.3.3 Theory application . . . . . . . . . . . . . . . . . . . . . . 27

2.3.4 On apparent counterexamples . . . . . . . . . . . . . . . . . . 33

2.4 Anaphoric identity comparatives . . . . . . . . . . . . . . . . . . . . 40

2.4.1 Context dependency of anaphoric *same* and *different* . . . . . 40

2.4.2 Deriving the scope difference . . . . . . . . . . . . . . . . . . 42

2.4.3 Extend the analysis . . . . . . . . . . . . . . . . . . . . . . 45

2.4.4 Theory comparisons . . . . . . . . . . . . . . . . . . . . . . 47

2.5 More on the locality constraints . . . . . . . . . . . . . . . . . . . . 53

2.6 Chapter wrap-up . . . . . . . . . . . . . . . . . . . . . . . . . . . 57

**Chapter 3: Comparative ambiguities** . . . . . . . . . . . . . . . . . . . . . 59

3.1 Introduction . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 59

3.2 Data . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 60

3.2.1 Cross-linguistic ambiguities . . . . . . . . . . . . . . . . . . . 60

3.2.2 Variable scales for continuation . . . . . . . . . . . . . . . . . 63

3.3 The Proposal . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 65

3.3.1 The three-way logical connection . . . . . . . . . . . . . . . . 66

3.3.2 Deriving variable scales . . . . . . . . . . . . . . . . . . . . . 71

3.3.3 Explaining the typological pattern . . . . . . . . . . . . . . . . 76

3.4 Comparing theories on CAC operators . . . . . . . . . . . . . . . . . 82
3.4.1 Event-relative measurement . . . . . . . . . . . . . . . . . . . . 82
3.4.2 Source of the scale . . . . . . . . . . . . . . . . . . . . . . . . . 84
3.4.3 Scale segments . . . . . . . . . . . . . . . . . . . . . . . . . . . 89
3.5 Chapter wrap-up . . . . . . . . . . . . . . . . . . . . . . . . . . . . 96

**Chapter 4: Intrasentential anaphora in comparison** . . . . . . . . . . . . . . . 98
4.1 Introduction . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 98
4.2 Towards a unified comparative meaning . . . . . . . . . . . . . . . . 99
4.2.1 Not the anaphoric form of the phrasal *er* . . . . . . . . . . . . 99
4.2.2 Potential solution: intrasentential anaphora . . . . . . . . . . 101
4.3 Dynamic semantics . . . . . . . . . . . . . . . . . . . . . . . . . . . 103
4.4 Firstt attempt . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 108
4.4.1 Dynamic *er* . . . . . . . . . . . . . . . . . . . . . . . . . . . . 108
4.4.2 Interpreting the *than*-P first . . . . . . . . . . . . . . . . . . . 110
4.4.3 Generating different explicit comparative constructions . . . . 113
4.4.4 Summary . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 116
4.5 Parallelism in explicit comparatives . . . . . . . . . . . . . . . . . . 118
4.5.1 A taller man . . . . . . . . . . . . . . . . . . . . . . . . . . . . 118
4.5.2 Minimal number of participants . . . . . . . . . . . . . . . . . 121
4.5.3 Summary . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 123
4.6 Interpreting quantifiers in the *than*-clause . . . . . . . . . . . . . . . 123
4.6.1 A problem in the traditional approach . . . . . . . . . . . . . . 123

4.6.2 Wide scope reading without exceptional scope . . . . . . . . . 125
4.6.3 Problem with proportional quantifiers . . . . . . . . . . . . . 129
4.7 Second proposal . . . . . . . . . . . . . . . . . . . . . . . . . . 130
4.7.1 Comparative anaphora as postsupposition . . . . . . . . . . . 130
4.7.2 Solving the proportional quantifier problem . . . . . . . . . . 135
4.7.3 Comparing ways to generate the wide scope reading . . . . . . 140
4.7.4 Narrow-scope readings . . . . . . . . . . . . . . . . . . . . . 144
4.8 Blocking effect of the overt standard . . . . . . . . . . . . . . . 154
4.8.1 Where the first analysis fails . . . . . . . . . . . . . . . . . . 154
4.8.2 Destructive update . . . . . . . . . . . . . . . . . . . . . . . 155
4.8.3 Discourse dependency of additivity and continuation . . . . . 156
4.9 Chapter wrap-up . . . . . . . . . . . . . . . . . . . . . . . . . . 158

**Chapter 5: Comparing alternatives in a pair** . . . . . . . . . . . . . . . . . . 160
5.1 Introduction . . . . . . . . . . . . . . . . . . . . . . . . . . . . 160
5.2 Preview of the account of the internal reading . . . . . . . . . . . . 161
5.2.1 Previous theories . . . . . . . . . . . . . . . . . . . . . . . . 161
5.2.2 *The* interpretation of the internal reading . . . . . . . . . . . 164
5.2.3 Implementation using pairs . . . . . . . . . . . . . . . . . . . 166
5.3 Formal account of the internal reading . . . . . . . . . . . . . . . 168
5.3.1 Formal background . . . . . . . . . . . . . . . . . . . . . . . 168
5.3.2 Upgrading to pairs . . . . . . . . . . . . . . . . . . . . . . . 171
5.3.3 Lexicalized distributivity with pairs . . . . . . . . . . . . . . . 172

5.3.4 Internal comparisons on pairs . . . . . . . . . . . . . . . . . . . 173
5.3.5 Varieties of internal readings . . . . . . . . . . . . . . . . . . . . 175
5.4 A unified comparative meaning . . . . . . . . . . . . . . . . . . . . . 179
5.4.1 Comparative anaphora with pairs . . . . . . . . . . . . . . . . . 179
5.4.2 Comparative anaphora in the internal reading . . . . . . . . . 186
5.5 Theory comparisons . . . . . . . . . . . . . . . . . . . . . . . . . . . 188
5.5.1 Parallelism in a pair . . . . . . . . . . . . . . . . . . . . . . . . 189
5.5.2 Association with a non-local licensor . . . . . . . . . . . . . . 192
5.6 Chapter wrap-up . . . . . . . . . . . . . . . . . . . . . . . . . . . . 197
**References** . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 199

## LIST OF FIGURES


2.1 Derivation in the direct analysis of *John is taller than Mary* . . . . . . 23

2.2 A possible derivation of *John is taller* . . . . . . . . . . . . . . . . . . 25

2.3 Scope of the comparative marker . . . . . . . . . . . . . . . . . . . . 39

2.4 Checking relevance inside a noun phrase . . . . . . . . . . . . . . . . 43

3.1 Deriving the additive reading of *John bought more apples* . . . . . . . 67

3.2 Deriving temporal continuation in *it is still raining* . . . . . . . . . . . 68

3.3 Deriving the marginal reading of *Anthea is still tall* . . . . . . . . . . 73

3.4 Merger and fusion in additivity . . . . . . . . . . . . . . . . . . . . . 78

3.5 Merger and fusion in continuation . . . . . . . . . . . . . . . . . . . 78

3.6 Typology of CAC ambiguities . . . . . . . . . . . . . . . . . . . . . . 80

3.7 Subconstituent-modifying *noch* . . . . . . . . . . . . . . . . . . . . . 87

3.8 Composing *Mary is taller than John* in scale segment semantics . . . . 90

3.9 Composing the additive reading in scale segment semantics . . . . . . 92

3.10 Composing temporal continuation in scale segment semantics . . . . 93

4.1 Basic types . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 104

4.2 Visualized context updates of *John left* . . . . . . . . . . . . . . . . . 105

4.3 Deriving a CCP compositionally . . . . . . . . . . . . . . . . . . . . . 106

4.4 Cross-clausal anaphora to an indefinite . . . . . . . . . . . . . . . . . . 107

4.5 Composing the CCP *John is taller* . . . . . . . . . . . . . . . . . . . . . 109

4.6 Multiple correlates and cyclic scope-taking of the licensors . . . . . . 111

4.7 Composing *John is taller than Mary is* with order-switching *than* . . . 112

4.8 Updates of *John is taller than Mary is* with order-switching *than* . . . 112

4.9 Composing *there are more cats than there are dogs* with order-switching *than* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 113

4.11 Composing *More than three people left* . . . . . . . . . . . . . . . . . . 117

4.12 Two possible ellipsis resolutions in the traditional analysis . . . . . . 119

4.13 Difference in the scope of comparison . . . . . . . . . . . . . . . . . . 120

4.14 Two possible structures of comparative quantifier constructions . . . 122

4.15 Updates of *John is taller than some girl is* with order-switching *than* . 126

4.16 An output plural information state of *every student bought a book* . . 128

4.17 Updates of *John is taller than every girl is* with order-switching *than* . 128

4.18 Composing *John is taller than most girls are* with order-switching *than* 131

4.19 Composing *John is taller than Mary is* with postsuppositional *er* . . . 135

4.20 Updates of *John is taller than Mary is* with postsuppositional *er* . . . 135

4.21 Composing *John is taller than some girl is* with the postsuppositional *er* 137

4.22 Updates of *John is taller than some girl is* with postsuppositional *er* . 137

4.23 Partial updates of *John is taller than most girls are* with postsuppositional *er* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 140

4.24 Composing *John is taller than every girl is* with higher-order alternatives 146

4.25 Scope of degree maximization over an embedded universal in PCDRT 148

4.26 Scope of degree maximization over an embedded existential in PCDRT 149

5.1 Sketch of pair-based distributive updates in *every year John buys a boat* 167

5.2 Sketch of the internal reading in *every year John buys a bigger boat* . 168

5.3 Plural Compositional Discourse Representation Theory . . . . . . . . . 170

5.4 Pair-based distributivity . . . . . . . . . . . . . . . . . . . . . . . . . . . 174

5.5 Comparisons in the internal reading . . . . . . . . . . . . . . . . . . . . 175

5.6 Comparative updates in the external reading, using pairs . . . . . . . 181

5.7 Composing an explicit comparative with pairs . . . . . . . . . . . . . 183

5.8 Updates of *John is taller than Mary is* with pairs . . . . . . . . . . . . 183

5.9 Deriving the additive comparison using pairs . . . . . . . . . . . . . . . 185

5.10 Deriving temporal continuation using pairs . . . . . . . . . . . . . . . . 186

5.11 Composing the internal reading with the unified, post-suppositional *er* 187

5.12 Anaphoric test in the internal reading of *every year John buys a bigger boat* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 188

5.13 Updates of *every boy gave every girl a poem* with lists . . . . . . . . . 194

# CHAPTER 1
# INTRODUCTION

## 1.1 Overview

The main concern of this dissertation is the correct meaning representation of comparison in natural language. I propose that an English comparative marker, e.g. *er* in *taller*:

- always expresses a comparison between two alternatives (i.e. things of the same semantic type) on the same measurement function;
- always relates to the standard of comparison through anaphoric binding.

Comparative constructions are built on gradable predicates. In the past few decades, many important studies (Cresswell 1976, Stechow 1984, Kennedy 1997, a.o.) have shown that *degrees* – abstract entities corresponding to measurements on a certain scale – needs to be included in the semantic representation of gradable predicates. As such, the meaning of a comparative is usually taken to be a relation expressed through degrees. For example, the meaning of the gradable predicate *tall* in degree semantics is a relation between individuals and degrees of tallness (1) (in this dissertation I will take the *at least* interpretation of this relation, i.e. $x$ $\textsf{is}$ $d$-$\textsf{tall}$ is true just in case $x$'s height exceeds $d$) and the meaning of the comparison in (2) is cashed out as an ordering relation between degrees.

(1) $[\![\,\text{tall}\,]\!] := \lambda d \lambda x.\textsf{x is } d\textsf{-tall}$ $\qquad \textsf{d} \rightarrow \textsf{e} \rightarrow \textsf{t}$

(2) $[\![\,\text{John is taller than Mary}]\!] \rightsquigarrow \textsf{max}\,\{d \mid \textsf{tall}(d, \textsf{john}\} > \textsf{max}\,\{d \mid \textsf{tall}(d, \textsf{mary})\}$

There has been a good variety of theories differing on how to put together the meaning in (2) compositionally (3a) - (3c). However, they all share two features: that the comparative marker, e.g. *er*, has a semantic argument slot for the comparison standard (marked in blue in the lexical entries below), and that the comparison relation is characterized only in terms of a relation between degrees. My proposal can be seen as a plea to uproot both of these two views.

(3) a. $[\![\text{er}]\!] := \lambda P \lambda g \lambda x. \exists d : gdx \wedge \neg Pd$ $\qquad (\mathsf{d} \to \mathsf{t}) \to (\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(Seuren 1973)

b. $[\![\text{er}]\!] := \lambda d \lambda g \lambda x. \exists d' : gxd' \wedge d' > d$ $\qquad \mathsf{d} \to (\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(Rullmann 1995)

c. $[\![\text{er}]\!] := \lambda P \lambda Q. \mathsf{max} P > \mathsf{max} Q$ $\qquad (\mathsf{d} \to \mathsf{t}) \to (\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(Heim 2000)

In my analysis, degrees remain a useful tool for measurement, but the meaning of comparison is fundamentally about the relation between two things under comparison, not just two (possibly random) degrees. The meaning of *John is taller than Mary* is characterized as an ordering relation between John and Mary in terms of their tallness. While this characterization is truth-conditionally equivalent to (2) for this very sentence, the proposed theory makes distinct predictions regarding the three other empirical phenomena studied in the rest of this dissertation:

- **Discourse dependency of comparatives used without an overt standard.** These are comparatives in utterances like *Mary is six feet tall. John is taller.* They rely on the prior context to provide a relevant standard degree, and it is observed that the dependency relation is more restricted than plain degree anaphora.

- **Cross-linguistic ambiguities between comparison, additivity, and continuation.** Morphemes that can express one of the three meanings are repeatedly attested in different languages. For instance, English *more* also has an additive reading; German *noch* is ambiguous between an additive reading and a continuative reading ($\approx$ *still*).

- **The internal reading of comparatives.** These are uses of comparatives in sentences like *every year John buys a bigger boat*: the comparison is *internal* in the sense that it does not rely on the clause-external context to provide the relevant standard.

None of these phenomena can be easily handled in the traditional approach. All of them have received (partial) analyses; in each case, the existing theories resort to complicate the comparative meaning in the traditional approach in a different way: introducing eventualities (for discourse anaphoric comparatives), introducing scale segments (for comparative ambiguities), and introducing a secondary context (for the internal reading). There is not yet a theory that addresses all of these seemingly very different complications together, as well as their relation to the comparatives' use in explicit comparative constructions like *John is taller than Mary*.

My dissertation presents such a theory. In my analysis, all of these phenomena stem from a common core, i.e. that the comparative expresses a comparison between two alternatives on the locally derived measurement function (we will see a little more details in section 1.2). The only difference between these different uses of a comparative is how the comparative gets bound by the alternative that is its comparison standard.

## 1.2 Comparing alternatives

In my theory, the comparative introduces its comparison standard – a (series of) standard correlate(s) and its corresponding measurement – not through function application with a semantic argument, but as its own implicit arguments. It gets access to the targeted measurement function via scope-taking.

The scope of the comparative is parasitic on the scope-taking of another operator in the same sentence. In its simplest form, this parasitic scope can be implemented as syntactic tucking-in (Richards 2001). Following standard practice (Kratzer and

Heim 1998), when an operator takes scope, it creates a $\lambda$-abstraction between its scope position and the trace it binds. This creates an opportunity for the comparative marker to intervene: it then takes scope right above the $\lambda$-abstraction of its licensing operator, creating a measurement relation in its own scope. (4) demonstrates a resulting structure: once the subject *John* takes scope, the comparative can take scope above its abstraction node, which creates a relation of type $\mathsf{d} \to \mathsf{e} \to \mathsf{t}$ in its own scope, i.e. $\lambda d \lambda x.x$ **is** $d$-**tall**. This is a measurement relation, because using it we can plug in any given entity of type $\mathsf{e}$ and project its maximal tallness degree. $[\![\text{er}_{y,d'}]\!]$ thus gets to compare the target of the comparison (i.e. the variable bound by its licensing operator) and the standard of comparison (i.e. the standard correlates it is co-indexed with) on this derived measurement function.

(4) $[\text{John}\,[\,\text{er}_{y,d'}\ \lambda d \lambda x[\,x \text{ is } d\text{-tall}\,]\,]\,]$

(5) $[\![\,\text{er}_{y,d'}\,]\!] := \lambda f \lambda x.\underline{d' = \mathsf{max}\,\{d \mid fyd\}}.\mathsf{max}\,\{d \mid fxd\} > d'$

$$(\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$$

Using this mechanism, we can generate comparisons between the variable bound by any (combinations of) scope-takers in the containing sentence and an alternative value, on the locally derived measurement relation that is the scope of the comparative marker. The *only* additional constraint it generates on possible comparative meanings, in comparison to the traditional approach, is that the standard degree is constrained to be the measurement of the standard correlate on the given function – imposing ordering relations to a bare degree is not allowed. This constraint turns out to be the crucial ingredient in our explanation of a number of phenomena.

The alternative comparison is glued to the expressions denoting the standard (i.e. the correlate and the degree) through anaphora. As hinted above, different uses of a comparative only differ in how the implicit argument of the comparative marker gets bound. In a discourse anaphoric comparative, it is bound by antecedents in the prior discourse, e.g. *John* and *ten* in (6). In an explicit comparative construction, it is bound by semantic objects introduced in the complement of *than*, e.g. in (7), *John* and the amount of books John read – the latter is introduced by a covert degree operator in the *than*-clause. In the internal reading of (8), it is bound by the set of years in the domain of *every* and the interestingness degrees of books Mary writes in those years, which will be present in the output context of the distributive quantification.

(6) John read ten books. ... Mary read more (books).

(7) Mary read more books than John did.

(8) Every year Mary writes a more interesting book.

While the simplest entry in (5) suffices to demonstrate the basic idea, it is revised in chapter 3-5 in order to provide a fully compositional account of the various phenomena. Upon each revision, I will show that the new lexical entry is only an upgrade: it preserves all the benefits of the previous version of the analysis, while revealing more intricate details of the comparison meaning.

The final formal analysis settled in chapter 5 is (9), a relation between a (dynamic) degree property to a context change potential (; denotes dynamic conjunction, $\textsf{\textbf{MAX}}^n$ is value maximization relative to its scope).

(9) $\textsf{\textbf{er}}^{\perp u,n}_{u',n'} := \lambda f.\exists^{\perp}u; \textsf{\textbf{MAX}}^n(fn); >_n;^{\underline{\perp u=u', \perp n=n'}}$

$$\langle S, S' \rangle [\exists^{\perp} u] := \{\langle I, I' \rangle \mid I = S, I' \in S'[\exists u]\}$$

$$>_n := \lambda \langle S, S' \rangle . \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid S_n > S_n\}$$

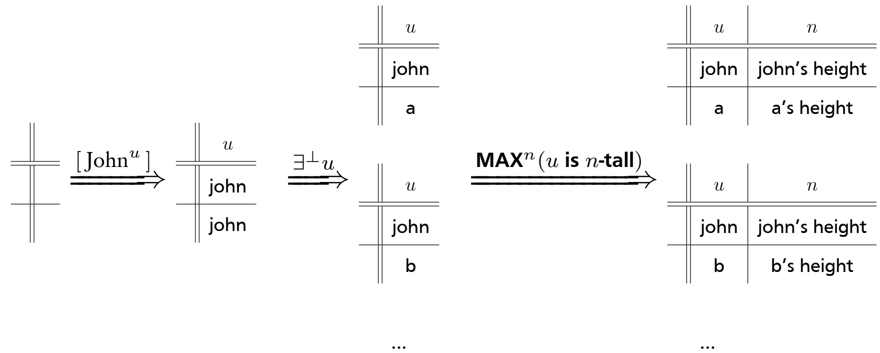
(9) is different from the simplest entry in (5) in two respects. The first is in the introduction of *er*'s implicit argument. In lieu of directly pointing to *er*'s antecedents, as in (5), the standard correlate of comparison is now first introduced as an indefinite object, which later gets specified through anaphoric resolution, along with its measurement. Couched in a dynamic semantics, the anaphoric resolution is formulated as a *postsupposition* (Farkas 2002, Lauer 2009, Brasoveanu 2012), i.e. a de-

layed dynamic update (indicated as a superscripted update). Analyzing the anaphoric component of the comparative as a postsupposition proves to be helpful when the targeted antecedents must enter the semantic computation later than *er*: the explicit comparative construction, and (later) the internal reading.

The second difference is in the way the comparative takes parasitic scope. In the dynamic framework adopted in chapter 5, sentence meanings are formally represented as relations between two-part contexts, i.e. *pairs* of information states that are normally mirror images of each other (Bumford and Barker 2013, cf. Brasoveanu 2011, Bittner 2014). This upgrade is motivated by the need to provide a compositional analysis of the internal reading. On top of that, it also allows *er* to take parasitic scope without syntactic tucking-in: as long as *er* is in the scope of its licensing operator $Q$, it can re-write the value of the variable $u$ bound by $Q$ in the secondary state; crucially, because normal lexical relations like $\mathsf{tall}$ are checked point-wise in a pair, the maximal degree dref *er* introduces now points to the measurement of the primary $u$-value in the primary state and the measurement of the secondary $u$-value in the secondary state. After this, the ordering relation is imposed on these two degrees – two values of the same degree dref.

For instance, in the final analysis, the LF structure of *John is taller* we need is (10): sitting in the scope of *John*, *er* gets to re-associate the secondary value of the variable bound by *John* to some random individual nondeterministically; it then proceeds to introduce maximal degrees that satisfy its scope property, which are the height of John in the primary state and the height of the value associated with $u$ in the secondary state. This part of the updates is illustrated in (11). The comparative then checks if the former does exceed the latter in a pair, before resolving the identity of the secondary alternatives in a later context.

(10) $[\,\text{John}^u\ \lambda u[\,\text{er}_{y,d'}^{\perp u,n}\ \lambda n[\,u \text{ is } n\text{-tall}\,]\,]\,]$

(11) 


## 1.3 Building the theory

The next four chapters build towards the final proposal little by little. Each chapter begins with an empirical challenge, and presents a version of the theory that is just enough to solve the problem.

### 1.3.1 Discourse anaphoric comparatives

Chapter 2 provides the initial observation that challenges the traditional view. It deals with utterances like (12): the comparative is without an overt *than*-clause/phrase, but we can infer the comparison standard from information in the first sentence, and interpret the comparative as John read more than ten books.

(12) Mary read ten books. ... John read more (books).

I will argue that this use of the comparative is discourse *anaphoric*, and that the null hypothesis of traditional comparatives – taking the comparative marker as merely imposing a degree relation – for comparative anaphora is that it is merely anaphora to a degree. However, this is shown to be not true. Comparative anaphora is often infelicitous when anaphora to the intended degree antecedent is.

The additional restrictions can be explained in the alternative-comparison approach. The lexical entry in (5) predicts that *er* is anaphoric to both a comparison correlate and a degree, and it imposes a definedness constraint that the antecedent degree is the (maximal) measurement of the antecedent correlate on the given measurement function. In contexts where a salient antecedent degree is available but the context does not entail it to be the measurement of the correlate, this definedness condition is not met, and thus comparative anaphora is expected to fail.

### 1.3.2 Explicit comparatives

Chapter 3 and 4 extends the alternative-comparison meaning back to explicit comparatives. The guiding intuition is that the basic meaning in (5) can fit into an explicit comparative if the comparative can be bound by semantic objects introduced in the complement of *than*. Roughly, in *John is taller than Mary*, we wish the implicit standard correlate to be bound by *Mary* in the *than*-clause, and the implicit standard degree to be bound by the height of Mary, which is going to be introduced by a covert degree operator inside the *than*-clause, Op (Chomsky 1977):

(13) [ [ John$^x$ [ er$_{y,d'}$ $\lambda d \lambda x$ [ $x$ is $d$-tall ] ] ] [ than [ Op$^{d'}$ $\lambda d'$ Mary [ is $d'$-tall ] ] ] ]

$$\text{Op} := \lambda f . \exists m = \mathsf{max} f$$

However, since these binders are not in the discourse prior to *er*, nor are they in a position C-commanding *er*, how to achieve the desired binding relation compositionally cannot be straightforwardly answered.

In Chapter 3, I propose to re-cast the lexical in (5) in dynamic semantics, which allows us to switch the interpretation order of the matrix comparative clause and the *than*-clause. When the *than*-clause is interpreted first, the discourse referents introduced in the complement of *than* can dynamically bind *er*.

In Chapter 4, I propose the following revisions of the theory:

- *er* first introduces the implicit standard alternative as an indefinite object, which is later specified to be identical to a certain discourse antecedent. This is made possible in a dynamic semantics, where an existentially quantified variable can still be picked up and elaborated on in later contexts.

- The anaphoric resolution of the standard alternative (and its measurement) is formally characterized as a postsupposition, i.e. a kind of dynamic update that can be discharged not immediately, but passed on to a later output context. Delayable dynamic tests like this have been independently motivated by a diverse set of phenomena.

With these changes, the meaning of *John is taller than Mary* will eventually come out as the following set of updates:

(14) $\exists v; \textsf{john's height} > v\textsf{'s height}; \textsf{mary} = v; \underline{\textsf{mary} = v; \textsf{mary's height} = v\textsf{'s height}}$
$\rightsquigarrow$ John is taller than someone, and Mary is that someone.

The asserted $\textsf{mary} = v$ is contributed by the covert Op inside the *than*-clause, i.e. Op asserts that the explicit correlate in the *than*-P is identical to the implicit correlate introduced by *er*. This may seem redundant in (14), given that it is already included in the anaphoric condition that will be discharged later, but I will show that this asserted identity relation is required to make sense of quantification inside the *than*-clause.

### 1.3.3 Comparative ambiguities

In Chapter 4, I also show how the proposed theory of comparatives can be used to explain a cross-linguistically attested morphological connection. That is, a lot of languages have morphemes that are ambiguous between the meaning of comparison, additivity, and continuation.

As an example, English comparative marker *more* can acquire an additive reading in a context like (15), in which case it is true so long as I bought any apples in addition to the apples Mary bought. As another example, German *noch*, though not a comparative marker, can express the same additive meaning as *more* in (15), and in sentences like (16) it can also have another meaning, which roughly conveys, in this sentence, that the event continues from a past time to the present. There are also languages that have a comparative marker that can acquire the meaning in both (15) and (16).

(15) – How many apples did the two of you buy?
– Mary bought five apples, then I bought three more.

(16) Es regnet noch.
it rains still
"It is still raining."

In order to explain these recurrent ambiguities, we need to show the logical connection between the three meanings, i.e. that one is derivable from another. So far as I know, the only theory that addresses this issue is Thomas (2018), and the theory is couched in scale segment semantics for comparatives.

I will show that a comparative meaning based on alternative comparison can make the logical connection just as well. In my analysis, additivity in (15) is no more than a comparison between the *sum* of the two alternatives of comparison, and the standard alternative alone: (15) is true so long as the apples bought by John *and* Mary exceeds the apples bought by Mary alone. As for continuation, the contribution of the continuative operator *still* in (16) is that it adds a presupposition that there is an earlier time such that it has been raining since then. I will show that this can be captured as a presupposed additive comparison between alternative times.

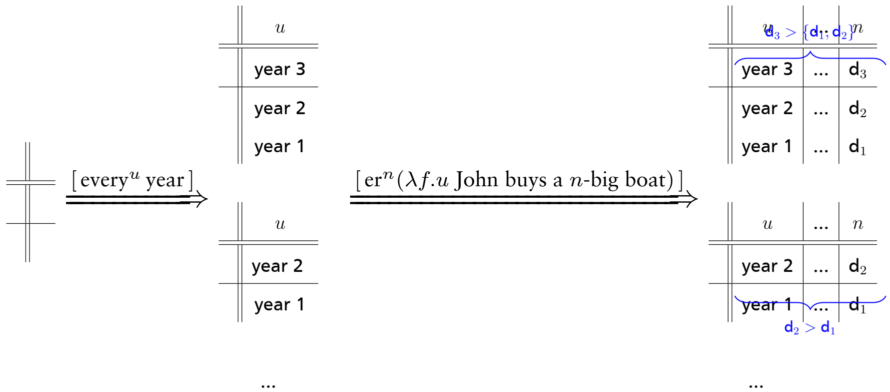
In addition to being ontologically simpler (as it does away the use of scale segments), this theory also has a better empirical coverage: e.g. it has the extra flexibility to derive the non-temporal uses of continuative operators like *noch/still* (salient in *Tom is still tall*) that are systematically undergenerated in Thomas' analysis.

### 1.3.4 The internal reading

My proposed theory as in Chapter 4 has difficulty in providing an account of the internal reading in sentences like *every year John buys a bigger boat*, but Chapter 5 goes on to show that this difficulty is only superficial. Alternative comparison can provide a fully unified comparative meaning once we think of the *alternatives* under comparison as alternative values of the same variable in a pair of information states.

The first part of the chapter shows how the introduction of pairs helps derive the internal reading. When sentence meanings relate, not single informational states as in standard dynamic semantics, but *pairs* of info states (where the second member of a pair can be seen as a secondary context), it is possible to define a distributive update that distributes over pairs of entities drawn from the distributive domain. This way, the comparative marker in the nuclear scope of the distributive quantification will have access to the pairs that a higher-up *every* passes over, and take them to be the correlates of the comparison. The updates are visualized in (17): as *every* passes on pairs of a later year and the years before, *er* gets to compare the years in the primary state and the years in the secondary state in terms of the degree property in its scope: in each pair in the output context, *er* stores the maximal bigness degree of the biggest boat John boat bought in the years stored in that state – here $\mathsf{d}_1$ is the maximal bigness degree of the biggest boat John bought in year 1, $\mathsf{d}_2$ the maximal degree in year 2, and $\mathsf{d}_3$ the maximal degree in year 3; it then requires that the degree in the primary state exceeds the degree stored in the secondary state[1]. This derives the correct internal reading: each year John buys a boat that is bigger than the biggest boat he buys in previous years.

[1] $\mathsf{d}_3 > \{\mathsf{d}_1, \mathsf{d}_2\}$ will be interpreted as $\mathsf{d}_3 > \mathsf{d}_2, \mathsf{d}_3 > \mathsf{d}_1$. See details in the degree plurality framework introduced in chapter 3.

(17) 


The second part of this chapter unifies this pair-based meaning of *er* and the analysis that has been developed. The upshot is that we can re-cast all of the previous analyses using the pair-based lexical entry in (9), and that the added components of alternative introduction and anaphoric resolution will have no observable impact in the derivation of the internal reading, so (9) still derives the targeted internal readings as before.

# CHAPTER 2
# DISCOURSE ANAPHORA IN COMPARISON

## 2.1 Introduction

This chapter studies the use of a comparative in cases like (18), where an overt *than*-P is absent and we rely on the clause-external context to provide a relevant comparison standard. In (18), the standard is inferred from the first sentence and the comparative is understood to be *(Mary read) more than ten books*.

(18) John read ten books. ... Mary read more (books).

Despite the mountains of literature on comparative semantics, very few has been dedicated to this particular use and its context dependency (but see Sheldon 1945, Schwarzschild 2011). It seems harmless to assume that the discourse context supplies whatever would have been supplied by the *than*-P (cf. Gawron 1995) and thus uses like (18) have no particular bearing on the semantics of comparison in Enligsh, right?

This chapter gives a negative answer, drawing on novel observations on the context-dependency of amount comparatives (i.e. comparatives with cardinality and mass measures). I will argue that the null hypothesis following the traditional approach to comparative semantics overgenerates, and the actual constraints we see will follow immediately if we switch to a re-analysis of *er*.

In what I refer to as the traditional approach, one idea has been held constant across the diverse group of analyses, namely that the meaning of the English comparative marker *er* denotes a transitive relation between two degrees. The proposed lexical entries fall into variants of either (19) or (20), depending on whether the denotation of the standard argument of *er*, i.e. the *than*-P, is a single degree (19) or a degree set (20).

(19) $[\![\text{er}]\!] := \lambda d \lambda g \lambda x . \exists d' : g d' x \wedge d' > d$ Rullmann (1995), a.o.

(20) $[\![\text{er}]\!] := \lambda P \lambda Q . \mathsf{max} Q > \mathsf{max} P$ Heim (2000), a.o.

In the re-analysis I'm offering, *er* never compares bare degrees. Instead, it compares two (series of) correlates on a given measurement function. We'll see that this predicts the observed constraint: a contextually salient degree can only serve as the standard of comparison if it is understood to be the measurement of the correlate on the given function.

The rest of this chapter is arranged as follows. Section 2.2 presents the main empirical observations, followed by a discussion on the underlying theoretical issue. The upshot is that while the null hypothesis following the traditional approach predicts cases like (18) to be nothing different from degree anaphora, the data show that is not true: amount comparatives' anaphoric uses are sensitive to a larger context containing the intended antecedent degree, in a way that plain degree anaphora isn't. Section 2.3 presents the proposal, building on the direct analysis on English phrasal comparatives. After demonstrating its immediate success in explaining the observed constraints, section 2.4 extends the proposal to treating analogous data patterns observed on identity comparatives *same/different*. Since the theory revolves around scope, section 2.5 examines its predictions in island effects. Section 2.6 concludes.

## 2.2 Data

### 2.2.1 The null hypothesis for anaphoric comparatives

I will call uses of a comparative as in (18) *anaphoric comparatives*[1]. This label is justified by the fact that the kind of context dependencies they exhibit parallels ex-

[1] Sheldon (1945) and Schwarzschild (2010) have used the term *incomplete comparatives* to refer to essentially the same category here. I believe that term can get confusing in the context of this dissertation, since another type of comparative – also without an overt standard marker hence also *incomplete* in Sheldon's definition – exhibits distinct patterns in their context dependency, and will be the topic of Chapter 5.

actly that displayed by ordinary anaphoric pronouns, as witnessed by the following examples (21) - (28):

- Deictic, non-linguistic antecedent:

(21) (Pointing to a customer) I can't close the store until she leaves.

(22) (Someone hands me a copy of *War and Peace*). No, I need a more interesting book.

- Deictic linguistic antecedent:

(23) A linguist$^x$ came in. She$_x$ sat down.

(24) John read *War and Peace*. Mary read a more interesting book.

- Quantificational subordination:

(25) Harvey has a$^x$ guard with him at every convention.
He$_x$ is usually one of Harvey's long-time friends.

(26) Every department hired a linguist. The linguist they hired usually has a backup offer for a better-paid job.

- Donkey anaphora:

(27) Every farmer who owns a$^x$ donkey beats it$_x$.

(28) Every student who read a book from my list recommended a more interesting one in their report.

But what exactly is the antecedent in these cases? If one follows the traditional comparative semantics to assume the meaning of *er* takes a standard argument, and if one also reasonably expects *er*'s meaning to be constant with or without the *than*-P, then $[\![\text{er}]\!]$ needs a standard argument in anaphoric comparatives as well. Therefore, I take (29) to be the fair null hypothesis that follows from the traditional approach (cf. Gawron 1995).

(29) In anaphoric comparatives, the standard argument of $[\![\text{er}]\!]$ is reduced to a covert pro-form.

Now without taking a position as to whether (29) has ever been taken literally, I will be concerned with evaluating its consequences. Discourse anaphora is simple. It requires only that there be exactly one most salient discourse referent (of the right type) that is logically accessible (given scope constraints) and satisfies the descriptive restrictions imposed by the anaphoric trigger. With (29), then, we expect successful resolutions when the discourse supplies one salient antecedent that is a degree (set). As it turns out, this prediction is not empirically supported.

### 2.2.2 Anaphoric amount comparatives

In what follows, I will showcase a series of examples where the anaphoric amount comparative is infelicitous, even though a salient antecedent degree of amount is available in the context. A little notational note: co-indexation between a comparative morpheme and a degree indicates that degree is the intended standard degree. For instance, the amount comparative in (30), bearing the same index as *ten*, is intended to be read as roughly *more than ten*.

(30) John read ten$^{d}$ books. ... Mary read more$_{d}$.

*Sensitivity to negation*

Anaphoric amount comparatives are sensitive to the polarity of the sentence containing the antecedent degree.

In (31), when the clause containing the intended degree is negated (i.e. read as *it is not the case that John read ten books*), the use of the comparative in (31a) is infelicitous under the intended *more than ten* reading. The reason is not because the negation somehow cancels the discourse potential of the degree in its scope: the fact that the degree demonstrative *that* in (31b) is unaffected suggests *ten* is still an available and salient antecedent[2] , it just can't be picked up by the anaphoric comparative. Even more tellingly, the explicit comparative in (31c) taking the anaphoric degree demonstrative as the *overt* standard is also felicitous. If the antecedent of (31a) is only anaphora to a degree, (31a) should be synonymous to (31c), but we observe a clear difference between the two, only the anaphoric use is stubbornly sensitive to the negative polarity.

(31) John didn't read ten$^{d}$ books. ...

a. # Mary read more$_{d}$ (books).

b. I have never seen that$_{d}$ many books on his shelf.

c. (But) Mary read more (books) than that$_{d}$.

Note that when the continuation *Mary read more (books)* in (31a) is used in a context where it has been established that John and Mary are *expected* to read ten books, *more* can have an acceptable *more than ten* reading. However, I would argue that in these cases the antecedent of the comparative is not really the degree in the negated sentence, but rather the degree of the expectation. The issue here is that when no other contextual information is available, (31a) clearly contrasts with (31b) and (31c).

*Sensitivity to predicate meaning*

Anaphoric amount comparatives are also sensitive to the meaning of the verbal predicate in the clause containing the intended standard degree.

[2]Given that negation usually kills the discourse potential of the indefinite object in its scope, why this is so is, of course, curious. One obvious solution is to take measure phrase/degrees as definites/names (Law 2019). If so, we can expect their discourse potential to parallel that of individual names, i.e. it transcends the scope of negation.

In (32) - (33), we see that the antecedent predicate doesn't have to be identical to be the local one, but not all kinds of differences are equally allowed. (32) shows alternating between *criticized* and *praised* is acceptable, while (33) shows the alternation between *criticized* and *read* sounds rather awkward, if not categorically bad. Again, we can confirm that this sensitivity to predicate meaning is not observed on plain degree anaphora in the same environment: the minimally contrasting explicit comparative in (33b) is perfectly felicitous; the awakwardess is truly only due to the anaphoric use of the comparative.

(32) John criticized ten$^d$ books. ... He praised more$_d$.

(33) John criticized ten$^d$ books. ...

a. ?? He read a lot more$_d$.

b. He read a lot more than that$_d$.

Comparing (32) and (33), we can reasonably hypothesize that the predicate in the antecedent clause needs to be *parallel* to the local predicate, in the sense that there is a non-trivial common theme between them. *Criticized* and *praised* would satisfy this constraint, because both are ways of evaluations. *Criticized* and *read* don't, at least in this out-of-blue context, as there seems to be no non-trivial, *a priori* category that subsumes both criticizing and *reading*.

Looking at a wider range of data, it seems while the parallelism constraint appears to be on the right track, whether two predicates are parallel to each other or not is ultimately context-dependent. Compare (34) and (35). (34) shows the anaphoric *more* with a *found-lost* pairing is strange at best. Given the hypothesized parallelism constraint, this would be because *found* and *lost* are not parallel predicates. Yet, when (35) clearly indicates that, in the given context, *found* and *lost* are both related to managing the coin collections of the team, the comparative anaphora becomes felicitous. We can say that this is because with the explicit context set-up, we can associate the meaning of two verbal predicates with the same teleological goal[3], in which case they are regarded as parallel by virtue of both being paths to the same goal. Anaphoric comparatives seem to be licensed without a problem in these contexts, even with predicates that don't belong to an *a priori* natural category.

(34) John found ten$^{d}$ coins. ... ?? Peter lost more$_{d}$.

(35) (Context: John and Peter teamed up to participate in a game. For each team, the task of the game is to walk through a forest, find the coins hidden in the forest, and collect as many as they can. The participating teams were all given a few sample coins at the beginning of their journey. In their team, John is responsible for finding the coins and John is responsible for keeping their findings. However, Peter was careless and lost lots of coins on the way.) John found ten coins, Peter lost more (so they walked out of the forest with fewer coins than before entering).

### 2.2.3 Summary and discussion

Throughout our examples, the clear contrast between anaphoric comparatives and degree demonstratives shows that anaphoric comparatives are of a distinct nature: they are sensitive to a bigger linguistic context in ways that plain degree anaphora isn't.

This is obviously detrimental to (29) under the assumption that the denotation of *than*-P is a single degree. Even if one takes the *than*-P to denote a degree *set*, I believe these findings are still detrimental, since it's always possible to derive a degree set by simply scoping the degree, as in (36) (cf. Barker 2013 for a similar account of property anaphora in sluicing), and thus the availability of a salient degree should also indicate the availability of such a derived degree set. Therefore, I take the failed anaphoric use of a comparative to be suggestive that (29) is not correct.

[3] I thank Simon Charlow for pointing this out to me.

(36) ten [$\lambda d.$ John read $d$-many book] .

We may still consider if these constraints are products of more general principles that are external to comparative semantics. For example, we may consider replacing an account of anaphora with ellipsis[4]; this might explain away the meaning parallelism constraint to the parallelism constraints governing ellipsis in general (see Kehler 2002, Wagner 2006, 2012, Katzir 2013, Büring 2016). Consider the example in (37), we can analyze this comparative to be underlyingly elliptical: assuming the absence of *than* is somehow acceptable (see Collins and Postal 2012, Collins 2017 on *ghosting*), the covert comparison standard in (37a) can be resolved to the degree property ($\lambda d.$ John read $d$-many books), it's elided because it's already present in the first sentence, just like the deaccented verb phrase in (37b). Now this use of comparative must be subject to some form of parallelism governing de-accenting, simply because it is a case of de-accenting.

(37) I think John read ten books. ...

   a. Mary read more ~~than~~ $\lambda d.$John read $d$-many books.

   b. Mary did read ten books too.

Unfortunately, this is about as far as the ellipsis-based analysis *can* get; it doesn't explain the rest of the data. Ellipsis licensing is only sensitive to the *givenness* of a certain constituent, it is not sensitive to *truth*. Therefore, the ellipsis in (37b) would still be perfectly acceptable even if the antecedent sentence is the negated one *I think John didn't read ten books* (modulo the presence of *too*). We thus have no explanation for why the anaphoric comparative in (37a) will be disrupted once the first sentence is negated. We need additional explanations for why anaphoric comparatives are sensitive to operators like negation whereas ellipsis in other environments

[4] Technically speaking, though, ellipsis and anaphora aren't necessarily mutually exclusive. In some analyses, e.g., Hardt (1999) and Charlow (2012), verb phrase ellipsis is anaphora to a property antecedent. If we take this view, then an ellipsis-based theory is not much different from anaphora to a degree property added with a discourse principle for congruence.

isn't, and it's not clear at all where these explanations can be found.

On the flip side, anaphoric comparatives can be used in contexts where ellipsis can't. To the best of my knowledge, ellipsis doesn't allow for antecedents that are entirely pragmatically construed. What I mean by pragmatically construed antecedents are usually seen in a phenomenon called *bridging* (Clark 1975): for example, in (38) the definite noun phrase *the driver* is, in some sense, anaphoric to the driver of the car mentioned, even though the driver itself is never explicitly mentioned and hence has to be pragmatically construed. This is possible for many anaphoric expressions (cf. Roberts 2003), but we can see that a similar attempt for ellipsis in (39) is flat out infelicitous: the same sentence *a car came in* should imply the same property, i.e. that it has a driver, and yet we can't pick this implied object as the antecedent for the attempted ellipsis in the second sentence.

(38) A car came in. The driver opened the front door.

(39) A car came in. # Another car $\lambda x.x$ has a driver, too.

Comparatives pattern with the definite noun phrase in (38) in this regard. Consider the example in (40): the importance of silence is obviously compared to that of baked goods, fresh coffee, and the luxurious furniture, even though the degrees to which they are important to Celia are never mentioned. (41) makes the same point with an amount comparative: *more* in the answer compares to the maximal amount of books John read, despite the fact that this degree is not mentioned in any way in the question.

(40) Neither the delicious baked goods, nor the fresh coffee nor even the luxurious furniture could draw Celia into Rob's new cafe. What finally caused her to enter was something invisible but to her mind far more important: silence.

Schwarzschild (2011): (36)

(41) – Where do you think you did better than John?

– Well, I read more books.

These differences between anaphoric comparatives and ellipsis is, of course, open to many possible interpretations. A most straightforward one is that an ellipsis-based analysis is neither sufficient nor necessary for what we've called anaphoric comparatives, because they are distinct phenomena. So I invite the reader to consider an alternative possibility: the unique context-dependency follows from the meaning of the anaphoric comparative itself.

## 2.3 Comparison between correlates

### 2.3.1 The direct analysis

On the conceptual level, the main change I'll propose, is that (anaphoric) comparatives compare two correlates on a given measurement dimension, as opposed to directly ordering degrees.

This idea is independently motivated by so-called *phrasal comparatives* such as *John is taller than Mary*, where the comparison is intuitively between John and Mary on the dimension of heights. And indeed, as an analysis for phrasal comparatives, it has been in the literature for a long time: see Bartsch and Vennemann (1974), Heim (1985) in particular[5]. After Heim, it became customary to call this *the direct analysis*.

I'll sketch the compositional implementation of the direct analysis in Bhatt and Takahashi (2007), since my compositional proposal will be derivative from it in a sense. *er* has the lexical meaning in (42) and takes scope in a way parasitic on the scope-taking of some other operator in the sentence (cf. Richards 2001, Barker 2007)[6]. Take the sentence *John is taller than Mary* for example. Suppose the subject *John* moves up (perhaps a reflection of its standard movement for EPP), *er* takes *parasitic scope* over the abstraction of the subject *John* and thereby creating the desired

[5] Although Heim's theory came later, it appears to be independently developed.

[6] The syntactic tucking-in will no longer be required once we re-cast the analysis in a specialized dynamic framework. See chapter 5 for details.

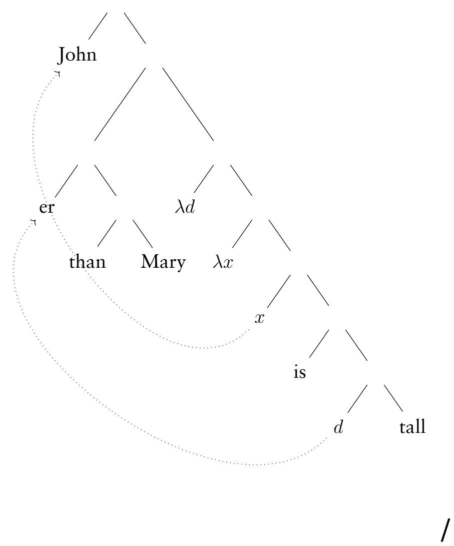



Figure 2.1: Derivation in the direct analysis of *John is taller than Mary*

measurement function of heights ($\lambda d \lambda x.\mathsf{tall}(d, x)$) as its scope argument. The structural derivation is shown in Figure 2.1. Plugging in the definition in (42), we arrive at the truth conditions that John's height exceeds Mary's height.

(42) $[\![\text{er}]\!] := \lambda y \lambda f \lambda x.\mathsf{max}(\{d \mid fdx\}) > \mathsf{max}(\{d \mid fdy\})$

Unfortunately, the direct analysis doesn't save the day. Combine this analysis with the null hypothesis in (29), our prediction for the anaphoric *er* would only change from degree anaphora to anaphora to a correlate (43), which wrongly predicts that an anaphoric comparative is equal to the corresponding phrasal comparative when the intended correlate can be retrieved from the discourse. Suppose (44) is uttered in an out-of-blue context; following it, (44a) sounds rather strange and infelicitous, whereas (44b) is perfectly acceptable. This is surprising for an account that equates comparative anaphora to anaphora to a correlate: since the first sentence in (44) does provide an antecedent correlate, i.e. *John*, the anaphoric comparative in (44a) should be felicitous. In fact, (44a) is predicted to be synonymous with phrasal comparatives in (44b). Similarly, we also predict that (45a) is synonymous with (45b) in the context of (45), but the fact is there is a clear contrast in acceptability between the two. At the end of the day, we still fail to account for anaphoric comparatives' sensitivity to the larger linguistic context.

(43) $[\![\text{er}_y]\!] := \lambda f \lambda x.\mathsf{max}(\{d \mid fdx\}) > \mathsf{max}(\{d \mid fdy\})$ $\qquad (\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(44) John$^y$ didn't read ten books. ...

a. # Mary read more$_y$ (books).

b. Mary read more books than John.

(45) John$^y$ criticized ten books. ...

a. ? Mary read more$_y$ (books).

b. Mary read more books than John.

That said, it turns out all we need is a small step forward from (42)/(43). In the next, I will pursue an analysis of *er* anaphoric to both a correlate *and* a standard degree. This one will achieve our goals.

### 2.3.2 Proposal

My proposal for the anaphoric comparative marker is in (2.2): this *er* is anaphoric to *both* a correlate $y$ and a degree $d'$, makes comparison to $y$ on its scope function while presupposing the maximal measurement of $y$ on this function would come out as $d'$ (I use the underline to indicate presupposition, which formally is a definedness condition):

(46) $[\![\text{er}_{d',y}]\!] := \lambda f \lambda x.\underline{d' = \mathsf{max}(\{d \mid fdy\})}.\mathsf{max}(\{d \mid fdx\}) > d'$

$(\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

Figure 2.2 sketches a possible derivation of *John is taller*. We can see the only structural difference from the direct analysis of *John is taller than Mary* (Figure 2.1) is that *er* has no argument slot for the standard. The end result provided at the top node is a comparison between John and the antecedent correlate $y$, whose height is also given in the discourse. In *Mary is six feet tall, John is taller*, the correlate could be

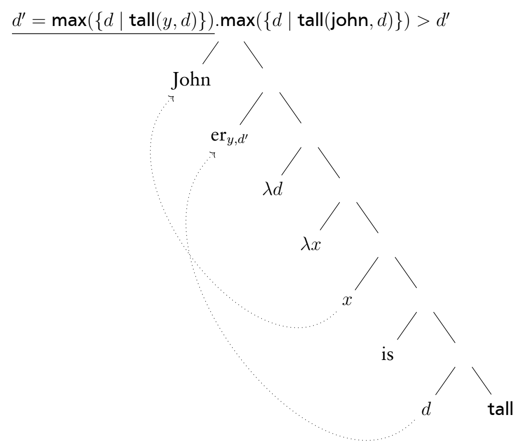



Figure 2.2: A possible derivation of *John is taller*

Mary, and the given height would be six feet. For cases when no degree antecedent is overtly mentioned, like (38) - (39), I assume they can be accounted for by whatever mechanisms underlying bridging anaphora in general (e.g. accommodation of a familiar discourse referent, as in Lewis 1979, Heim 1982).

The above derivation is only one of several possibilities, because *er*'s scope-taking may be parasitic on, and hence licensed by, *any* other scope-taker in the sentence. This has the power of deriving all sorts of different comparisons. In (47), when *er* is licensed by an intensional operator, the indicative mood operator IND, the comparison is between two possible worlds; assuming an antecedent intensional operator *told* makes possible worlds compatible with John's telling become discourse antecedents (cf. Stone 1997, Stone and Hardt 1999), we get the comparison between John's actual height to the addressee's report. In (48) is an attributive use of *er* inside a noun phrase. Assuming the determiner of the noun phrase takes scope (Heim 1982, Barker 1995, Charlow 2020), this *er* can scope inside the noun phrase, deriving a comparison between the referent introduced by *a* and an antecedent individual, *Mary*. Similarly, the amount comparative *er* can be licensed by the subject too (49), a scope-taking predicate in the sentence in (50) (I'll assume this scope taking is triggered by focus-marking on the predicate[7]), or quantificational operators like the indicative operator.

(47) You told$^{w'}$ me John is six feet tall. He is (much) taller$_{w'}$.

$\rightsquigarrow$ [ IND$_{@}$ $w$[ er$_{w',d'}$ $\lambda d\, \lambda w$[ He is$_w$ $d$-tall ] ]

(48) I thought Mary$^{u'}$ is quite tall. Today I finally met a taller$_{u'}$ woman.

$\rightsquigarrow$ [ a [ er$_{y,d'}$ $\lambda x \lambda d$ [ $x$[ $d$-tall woman ] ] ]

(49) John$^{u'}$ read five books. Mary read more$_{u'}$ (books).

$\rightsquigarrow$ [ Mary [ er$_{y,d'}$ $\lambda x \lambda d$ [ $n$-many books $\lambda z$[ $x$ read $z$ ] ] ]

(50) John criticized$^{P'}$ five books. He PRAISED more$_{P'}$ (books).

$\rightsquigarrow$ [ PRAISED [ er$_{Q,d'}$ $\lambda P \lambda d$ [ $n$-many books $\lambda z$[ He $x$ $z$ ] ] ]

The lexical entry in (46), however, can't handle cases like *John criticized five books. ... Mary praised more (books)* yet. (46) is only capable of deriving comparisons between exactly two correlates, but in this utterance the understood comparison is between two pairs of things: Mary's praising and John's criticizing. The solution seems obvious: we'll need to generalize the meaning of *er* to (51). With this, the targeted comparison can be derived as in (52), with multiple tucking-ins/parasitic scope-takings[8]: the derive comparison is a relation between multiple correlate (an individual and a predicate) and the corresponding reading amount, and we get to compare the amount of books Mary praised to the amount of books John criticized.

(51) $[\![ \text{er}_{y_0,\ldots,y_n,d'} ]\!]$ :=

$\underline{d' = \mathsf{max}(\{d \mid f d y_0 \ldots y_n\})}. \lambda f \lambda x_0 \ldots \lambda x_n . \mathsf{max}(\{d \mid f d x_0 \ldots x_n\}) > d'$

$(\mathsf{d} \to \mathsf{a}_0 \to \ldots \to \mathsf{a}_n \to \mathsf{t}) \to \mathsf{a}_0 \to \ldots \to \mathsf{a}_n \to \mathsf{t}$

(52) John$^{u'}$ criticized$^{P'}$ five books. Mary PRAISED more$_{P',u',d'}$ (books).

$\rightsquigarrow$ [ Mary [ PRAISED [ er$_{P',u',d'}$ $\lambda P \lambda u \lambda d$ [ $d$-many books $\lambda z$[ $v\, u\, z$ ] ] ] ]

[7] A scope-taking approach to focus marking has an (apparent) disadvantage in explaining the island-insensitivity of focus association. See Charlow (2014) for a way to make them compatible.

[8] In Chapter 5 I will present a version of the proposal in a specialized dynamic framework, in which no syntactic tucking-in is required for this kind of parasitic scope taking.

In the resulting theory, there is a lot of freedom in the meaning an anaphoric comparative can express. Any *combination* of expressions in the local clause can turn into a parameter of the comparison, by taking scope. Still, compared to the traditional approach where *er* directly orders bare degrees, this generates more restrictions on felicitous anaphora in comparison, which will explain our observations in section 2.2.

### 2.3.3 Theory application

*Explaining sensitivity to negation*

In my theory, an anaphoric comparative must find a contrasting element in the discourse to be its standard correlate, and, in addition, a degree antecedent that is presupposed to be the measurement of the correlate on the local measurement function.

The reason that the comparative can be sensitive to sentence polarity is because the negative polarity in those cases makes the confinedness constraint on the intended degree impossible to satisfy. In (54), the contrasting correlate is *John*, *Mary read more (books)* thus denotes a comparison between Mary and John's readings, with the presupposition that the antecedent degree is the (maximal) reading amount of John (54). This antecedent degree can't be *ten*, because the wide scope negation has denied that ten is that number, resulting in a presupposition failure.

(53) John$^{x'}$ read ten$^{d'}$ books. ... Mary read more$_{x',d'}$ (books).

(54) John$^{x'}$ didn't read ten$^{d'}$ books. ... # Mary read more$_{x',d'}$ (books).

a. $\rightsquigarrow \underline{d' = \textsf{max}\{d \mid x' \textsf{ read } d\textsf{-many books}\}}.$

$\textsf{max}\{d \mid \textsf{mary read } d\textsf{-many books}\} > d'$

In fact, in this limited context, there is no available degree antecedent that is John's reading amount. Therefore the comparative doesn't have any sensible reading (cf. (44a)) – at least, not without accommodation – because its semantic presupposition can't be satisfied.

In this explanation, the problem is not the negation *per se*, but that the negation cancels the measurement relation between the intended antecedent correlate and the intended antecedent degree (e.g. the negation in (54) negates the relation between john and ten). There are still cases where the measurement relation is not canceled in spite of the presence of the negation, we thus predict that in these cases negation won't disrupt comparative anaphora.

One such case is when the comparative is embedded in the right disjunct of a disjunction[9], as in (55). As the standard view holds that presuppositions are satisfied in local contexts and the local context of the right disjunct of "$p$ or $q$" will be the output context of "not $p$", we expect that the comparative in (55) is interpreted in a local context where John did read ten books, and so the presupposed relation between ten and john is satisfied. Indeed, we find (55) felicitous under the intended *more than ten* reading.

(55) Either John$^{x'}$ didn't read ten$^{d'}$ books, or (he did, and) Mary read more$_{x',d'}$ (books).

Another one is when the negation in the antecedent clause is interpreted low, in the scope of the degree; the negation doesn't negate the measurement relation because it is part of the measurement relation that the degree predicates over. For example, the low-scope negation reading of *John didn't read ten books* conveys that ten is the maximal amount of books John didn't read, and under this reading *ten* can be an antecedent degree of an anaphoric comparative. Suppose that John and Mary are supposed to read a collection of 20 books; John left out 10 books on the list, and Mary left out 15. We can use (56) to describe the situation, and the comparative here is understood to be *more than ten*. This is not surprising given my account, because in this context, the local comparison is derived by *er* scoping over the local negation,

[9] I thank Amir Anvari for raising this issue to me.

i.e. a comparison between the books John and Mary failed to read.

(56) John didn't read ten books. ... Mary didn't read (even) more (books).[10]

We can also turn the polarity itself into a comparison parameter. To achieve that, we will need to let the polarity operator (Laka 1990, Roelofsen and Farkas 2015, Holmberg 2015) take scope, supposedly by focusing, i.e. adding a focal stress to the auxiliary verb. For example, once we focus *did*, the positive polarity operator $\textsc{Pol}^+$ in (57) can take scope, and the comparative can generate a comparison between the books John did read and he didn't read (57a). In this case, (57) should also be felicitous under the *more than ten* reading. This interpretation is available, and even salient, in the following context: John read 90 out of the 100 books he's supposed to read, and (57) is uttered as a defense for him, which conveys that his achievement still outweighs the unfinished.

(57) John didn't read ten books. .... He DID read more.

a. $[\,\textsc{Pol}^+ [\,\mathrm{er}_{Q'} \lambda Q \lambda n\, [\, Q[\, n - \text{many books}\, \lambda z\, [\,\text{he read}\, z\,]\,]\,]\,]\,]$

By the same logic, shouldn't we expect to have a felicitous *more than ten* reading of an intonational variant of (54)?

(58) John didn't read ten books. ... Mary DID read more (books).

The account so far predicts that the comparative in (58) can generate a comparison between the books Mary read to the books John didn't read; then *ten* can be the understood standard as long as it scopes over the negation. This reading seems extremely hard to get. Yet, I think it does exist; the remaining awkwardness in (58) follows from the *pragmatic* constraint of comparative anaphora, which we now turn to.

[10] I thank Troy Messick for raising this example.

*Explaining sensitivity to predicate meaning*

The parallelism constraint on predicate meaning comes from pragmatic constraints on the anaphoric resolution, namely that the antecedent correlate should be a relevant one.

The idea, roughly, is that *praise* counts as a relevant alternative to *criticize* while *read* doesn't in an out-of-blue context. This seems intuitive, but turns out hard to capture in existing formalizations of relevance. The problem is that these formalizations either require sentence meanings to be (focus) alternative sets (e.g. the QUD congruence approach in Roberts 1996), or require an exhaustive interpretation, i.e. the relevant alternatives are innocently excludable from one another (Wagner 2012, Katzir 2013). Neither of these prerequisites is possible for anaphoric comparatives, whose interpretation is inherently relational (to the alternative) – the two correlates are present in the one asserted proposition, not alternative propositions in a set; the comparative proposition also cannot be true when the antecedent sentence is excluded (i.e. negated). We need a different formalization.

Following Lewis (1988), I define relevance as aboutness with regard to a (contextually salient) subject matter, formalized in (59): subject matters are equivalence relations between possible worlds, things we can intuitively think of as *the 17th century* and *how many stars there are*; a proposition is about a subject matter $Q$ iff its truth supervenes on $Q$, i.e., whenever $Q$ holds between two worlds $w, w'$ they give the same truth value to this proposition (see also Groenendijk and Stokhof 1984, for similar ideas in question semantics). With this, we can define the pragmatic principle in (60), restricting the antecedent to be one that makes the resolved proposition relevant to a salient subject matter.

(59) A proposition $p$ is about a subject matter $Q$ iff

$\forall w, w'$in the context set : $Qww' \rightarrow (pw = pw')$ Lewis (1988), p. 163

(60) *Resolution to a relevant antecedent*

Co-index expressions $A, B, \dots$ with the free variables $x, y, \dots$ in a proposition $p$ (... $x$ ... $y$...) iff this co-indexation makes $p$ about a salient subject matter.

(to be revised)

After anaphoric resolution, the proposition should be a relevant one. Let's see this principle at play in *John read two books. Mary read more*$_{d,y'}$ *(books)*. Resolving the two free variables of *more* introduces to $\textsf{john}$ and $\textsf{two}$ gets us a specified comparison, i.e. Mary read more books than the amount of books John read, which is two. The semantic presuppositions of *more* are satisfied, and the only question left to consider is if this proposition is relevant. Absent a larger discourse, it depends on whether or not we can construct a subject matter this proposition is potentially about. Here, this can easily be *people's reading amounts* – any two worlds that agree on people's reading amounts (if John and Mary are included) must also agree on whether Mary read more books than John. The anaphora is felicitous.

This constraint on relevance gives rise to the observed parallelism because parallelism in predicate meanings facilitates the construction of a relevant subject matter. In (61), we can easily construct *John's evaluations of books* as a potential subject matter: any two worlds that agree on John's evaluations surely also agree on whether he criticized more or praised more. Once we replace *praised* with *read*, as in (62), there seems to be no obvious subject matter that this comparison could be about, at least in this kind of out-of-blue context, exactly because there is no obvious common theme between the two events.

(61) John criticized ten books. He praised more.

(62) John criticized ten books. ?? He read more.

Note that there are at least two kinds of subject matters that an utterance like (62) *is* about, but which shouldn't be used to grant its relevance. The first is the Big Question in Stalnaker (1978), *What is the way things are?*, which is a question demanding a maximally specific list of descriptions of the current situation and therefore is a subject matter that any proposition is about, including (62). And yet, intuitively that does not make every proposition a relevant one at any given time of a discourse. Therefore generally subject matters we use to navigate the discourse must be more specific than the Big Question. The second kind is, for any given proposition, its own *whether*-question. (62) is obviously about the question *Whether John read more books than he criticized?*, simply because any proposition $p$ is about the question/subject matter of whether or not $p$. This fact shouldn't automatically make all the propositions relevant, so we must be more restrictive: a proposition $p$ is only truly relevant when we can find a subject matter different from whether $p$.

In this view, parallelism in predicate meanings comes from the pragmatic preference to make the comparison about a specific subject matter that is directly related to our immediate concern. Whether such a concern exists is contingent on the context, so it is not surprising that context manipulations can save anaphora with lexically non-parallel predicates. This is what happens with *John found ten coins. Peter lost more*, in (34) - (35). We've seen that the comparative anaphora to the first sentence is perfectly felicitous when the added context in (35) makes explicit that both finding coins and losing coins are related to managing their coin collections as a team. I've mentioned there that this contextual setting introduces parallelism by introducing a goal and temporarily making both predicates as paths to the same goal. Now we can sharpen our understanding of this process a little more: this context raises *How many coins did they collect?* as a salient subject matter, the comparison between finding and losing coins is a relevant one, as any two worlds agreeing on how many coins they collect would agree on whether they find more or lose more. In other words, introducing such a goal *is* introducing a contextually salient subject matter relevant to the comparison[11].

We now have a pragmatically driven explanation for the remaining awkwardness in (58). Even though the intended *more than ten* reading should be entirely possible to derive, it is strange because a context that makes the resulting proposition – a comparison between one person's activity to another person's opposite activity – relevant, is very hard to find. It does seem to be acceptable in some artificially construed scenarios where relevance is satisfied. Suppose John and Mary are both given a stack of twenty books. John's task is to read as few of them as possible while Mary is asked to read as many as possible. Then at the end of the day, when we compare their achievement, (58) appears to be an acceptable assessment.

In summary, we can account for the observed parallelism constraint by appealing to a pragmatic constraint of relevance. Even though relevance should hold for all anaphoric resolutions, it gives rise to the parallelism constraint in anaphoric comparatives precisely because the comparative – unlike a degree demonstrative – is interpreted as a comparison between *correlates*, not a comparison to a bare degree (set).

### 2.3.4 On apparent counterexamples

*When is the semantic presupposition failed*

The semantic presupposition of *er* forbids the intended standard degree to be *bare*, the local context must entail that this degree is the measurement of the intended correlate. It turns out that bare degrees are rare to find to begin with, which might explain why this constraint of comparatives' context dependency has not been more noticeable. Nevertheless, it appears whenever the degree is unequivocally bare, the comparative anaphora systemically fails.

[11] In fact, the kind of specific subject matters at play here seems a lot like the so-called *domain goals* in Roberts (1996).

Other than negation, questioning can also have the effect of canceling the expressed measurement relation between the intended antecedent degree and the intended correlate. Therefore, we predict that questioning disrupts comparative anaphora in the same way that negation does. This is attested in (63): while the degree demonstrative can pick up the degree antecedent *ten* in a question without a problem, that degree can't be the antecedent degree (i.e. the understood standard) for the anaphoric comparative in (63a).

(63) Did John read ten books?

a. ... Mary read more (books).

b. ... Mary read more than that, this I know.

Again, the comparative anaphora is disrupted here because the semantic presupposition of *er* is failed. *Mary read more (books)* is interpreted as a comparison between Mary and John in this context, with the presupposition that the antecedent degree is John's reading amount. This presupposition can't be satisfied with *ten* being the antecedent degree, because whether or not *ten* is the amount of books John read has been explicitly put into the question.

Another situation we see bare degrees is with pointing. As the theory predicts, the mere pointing to a number is not enough to provide a standard degree for an anaphoric comparative: it appears unacceptable to say *Mary/I read more*, pointing to the number *ten*, to convey an intended *more than ten* reading. On the other hand, *Mary read more than that (number)* can receive a *more than ten* reading with this pointing.

It's worth noting here that in some other seemingly similar situations, the intended degree actually isn't bare and the semantic presupposition is satisfied.

First, when the antecedent degree is contained in a modalized sentence. Modals and *if*-conditionals can cancel the truth entailments of a proposition just like negation and question (i.e. $\Box p$ does not imply $p$), but they don't fall into the same category when it comes to blocking comparative anaphora. The comparative in both (64) and (65) receives a felicitous and salient *more than ten* reading, suggesting that these modal operators don't block comparative anaphora.

(64) John is required to read ten books. He ended up reading a lot more.

(65) If John read ten books, I will be very surprised. However, Mary has already read a lot more, so I still think she will still win the competition.

The felicitous anaphoric readings in (64) - (65) are, in fact, expected in my account: they can be derived as the comparative generating a comparison across different possible worlds, something we have already seen in (48). These modal operators can introduce possible worlds as discourse antecedents, worlds where the prajecent proposition holds true (Stone 1997, Stone and Hardt 1999); picking up these worlds as a standard correlate, the comparative will generate a comparison between John's actual reading amount to his reading in a required-world in (64), and a comparison between Mary's actual readings to John's reading in an if-world in (65). Since ten is the maximal reading of John *in these worlds*, *ten* will be the understood standard degree, the semantic presupposition of the comparative is satisfied.

Another case is when the intended antecedent degree is wrapped in a modified numeral phrase and therefore is not asserted to be the precise measurement of the correlate[12]. For example, the *more* in both (66) and (67) seems to have a *more than ten* inference. Isn't this at odds with the current theory, since neither of the antecedent sentences in these two examples *entails* that John read ten books?

(66) John read more than ten books. ... Mary (also) read more/ Mary didn't read more.

(67) John read at most ten books. ... Mary read more.

[12]Issues of this kind have been mentioned to me by Dorothy Ahn, Amir Anvari, and Ciyang Qing.

We first need to exclude a confounding factor: comparative modified numeral phrases like *more than n/less than n* can't provide good tests for comparative anaphora, since the *than*-phrase in the comparative phrase can license an ellipsis reading of the comparative. That is, the interpretation of *more* in (66) is likely *Mary read more than ten books* (Collins 2017), and thus a different phenomenon.

The issue in (67) is more legitimate. Assuming the reasonable meaning for *at most ten* in (68) (Kennedy 2015) , we can see that the first sentence only says that the upper bound of John's reading amount is ten; it is consistent with John reading only nine books, or even zero book. Even so, I believe the possible *more than ten* inference is still consistent with the current analysis once we consider relevant pragmatic reasoning. The comparative sentence's literal interpretation is Mary read more than John, with *er* anaphoric to *John* and his reading amount[13]. This comparative statement can be truth-conditionally consistent with a situation where the speaker knows Mary only read, say, nine books, but it would be pragmatically unacceptable in that situation, since in that case the speaker must also know that John read less than nine and could have given a more precise description of John (e.g. *John read at most eight books*). If we take the interlocutors of a conversation to be cooperative and generally obey Gricean principles, these situations are ruled out by e.g. the principle of quality, and we get the *more than ten* inference as a result.

(68) $[\![\text{at most ten}]\!] := \lambda P.\textsf{max}P \leq 10$

That this *more than upper bound* inference is pragmatic is further supported by the fact it can be canceled. In a context where the speaker is obviously only tracking the relation between John and Mary's readings and doesn't necessarily know the precise reading amount of either one, (69) can be uttered, and in this case *more* does not induce a *more than ten* inference.

[13] In dynamic semantics, degree maximization like in (68) would require introducing a discourse referent for the degree, so John's reading amount is already in the context as an available discourse antecedent.

(69) John read at most ten books. ... Mary read more – I know because she read so much faster.

*Scope of the comparative marker*

All the data I have presented come from amount comparatives. This has a reason: adjectival comparatives (i.e. comparatives with an adjectival measure) don't exhibit the same kind of sensitivity to the clausal level content as amount comparatives do.

Adjectival comparatives are not nearly as sensitive to the negation in the antecedent clause. When the antecedent clause is negated as in (71), it is still possible to read the adjectival comparative as *more interesting than the book assigned to John* (71b), same as when the antecedent clause is positive (70).

(70) John read the book assigned to him. ...

a. Mary read more. $(> |\textsf{the book}|)$

b. Mary read a more interesting book. ($>$ interestingness of the book)

(71) John didn't read the book assigned to him. ...

a. Mary read more. $(\# > |\textsf{the book}|)$

b. Mary read a more interesting book. ($>$ interestingness of the book)

We also don't observe the sensitivity to predicate meanings on adjectival comparatives. (72) has a natural anaphoric reading that says Mary read a book more interesting than *War and Peace*, even though the verb pairing is *criticized/read*, a combination that has proved to be problematic for amount comparatives.

(72) John criticized *War and Peace*. ... Mary read a more interesting book.

With the current analysis of *er*, these differences between amount and adjectival comparatives can be explained as a result of their difference in the scope of comparison.

Corroborating evidence for this difference date back to Hackl (2000). Hackl observes that some sentences of the form *more than* $n$ *NP VP* are infelicitous, intuitively because the minimal number of participants for the activity denoted by VP already exceeds $n$. For example, *more than one student met* is infelicitous, intuitively because our world knowledge tells us a meeting activity requires at least two participants, and two already exceeds *one*. Hackl shows that we can derive this reasoning compositionally with two assumptions: (i) the gradable relation encoded in amount comparatives has the shape of a determiner, i.e. it obligatorily scopes over the verb phrase of the sentence; (ii) this gradable relation must also be interpreted in the complement of *than*. Together, these will make sure both NP and VP in *more than* $n$ *VP NP* are interpreted in the *than*-P, forcing $n$ to be interpreted as the number of NP participated in a VP activity.

Here we will only need the first assumption[14]. We can enforce this the same way Hackl does: de-compose *more* in amount comparatives into *many* and *er*; give *many* the meaning of a parametrized determiner in (73). In contrast, the gradable relation in an adjectival comparative is still the denotation of an adjective, e.g. (74).

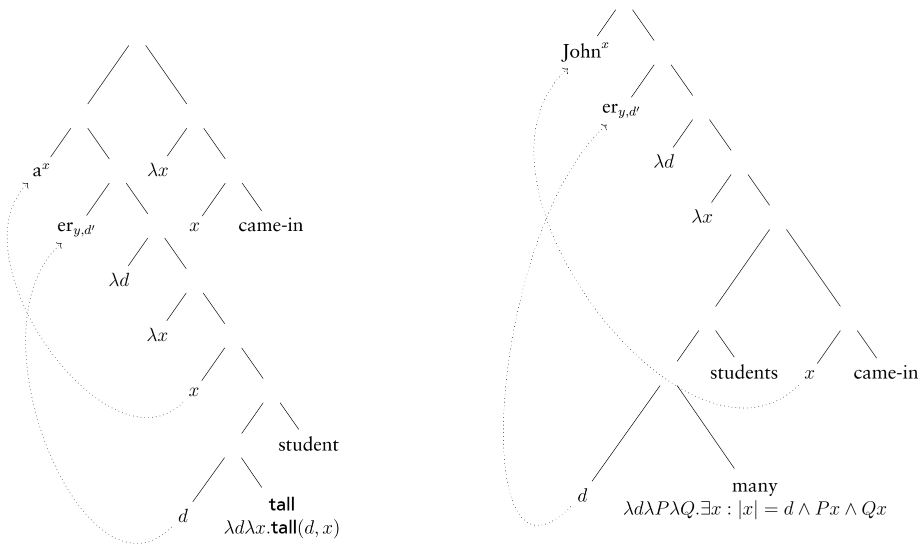
(73) $[\![\text{many}]\!] := \lambda d \lambda P \lambda Q. \exists x : |x| = d \wedge Px \wedge Qx$ $\quad\quad \mathsf{d} \to (\mathsf{e} \to \mathsf{t}) \to (\mathsf{e} \to \mathsf{t}) \to \mathsf{t}$

(74) $[\![\text{tall}]\!] := \lambda d \lambda x. \mathsf{tall}(d, x)$ $\quad\quad \mathsf{d} \to \mathsf{e} \to \mathsf{t}$

In my re-analysis of *er*, the gradable relation must be in the scope of the comparative marker (otherwise there will by no gradability in the comparative marker's scope argument), so this difference between *many* and adjectival measures entails a difference in the possible scope position of the comparative marker. In adjectival comparative, *er* has the option of scoping inside the noun phrase, as shown in Figure 2.3a. In amount comparatives, *er*, having to scope over the parametrized determiner *many*, must take scope at the clausal level too (Figure 2.3b).

The reason that adjectival comparatives can be insensitive to the clausal level content is precisely because of this narrow scope possibility. In (71), when *er* takes

[14] In chapter 3, when the current analysis is extended to explicit comparatives, we will see that we can get Hackl's facts without his second assumption.




(a) Adjectival comparative (b) Amount comparative

Figure 2.3: Scope of the comparative marker

noun phrase internal scope, the comparative meaning we derive will be (75): the presupposition is only that the antecedent degree is the maximal interestingness of the antecedent book. This can be satisfied by the book mentioned in the first sentence and the implied degree of its maximal interestingness (a case of bridging anaphora). All that *er* needs is an accessible book antecedent; the clausal negation does not affect the relation between this degree and the book, so the presupposition is satisfied regardless of whether the antecedent clause is negated or not.

(75) $$\frac{d' = \mathsf{max}\,\{d \mid \mathsf{book}\,y \wedge \mathsf{interesting}(d, y)\}.}{\exists x : \mathsf{book}x \wedge \mathsf{max}\,\{d \mid \mathsf{interesting}(d, x)\} > d' \wedge \mathsf{read}(x, \mathsf{mary})}$$

The insensitivity to predicate meanings is also consistent with my account. The comparison after resolution is only a comparison between two books, which are always parallel to each other because they are descriptively the same. Crucially, the verb phrase in the first sentence is not in the resolved proposition, so its meaning does not directly affect the satisfaction of our pragmatic condition at all.

In short, the anaphoric comparative can be insensitive to polarity or predicate meanings, if the comparative marker takes noun phrase internal scope and those clausal level content is thus outside of the scope of comparison. Amount comparatives, however, don't have this option. Because *er* in amount comparatives have to take clausal scope, the clausal level content is always in the scope of comparison; hence the observed sensitivity in section 2.2.

## 2.4 Anaphoric identity comparatives

Identity comparatives *same* and *different* can be used anaphorically, too. To wit, both (76a) and (76b) have a most salient reading in which the understood comparison standard is provided by the first sentence.

(76) Mary read *War and Peace*. ..

a. John read the same book.

b. John read a different book.

There have also been debates about what exactly the antecedent is in these uses. Hardt and Mikkelsen (2015)[15] calls into doubt the previously default assumption that it is the book *War and Peace* for both *same* and *different* (cf. Barker 2007, Brasoveanu 2011). The empirical observations they provided appear to mirror the patterns of scalar comparatives, therefore in this section I will extend the current account to identity comparatives to obtain a unified explanation on these phenomena.

### 2.4.1 Context dependency of anaphoric *same* and *different*

Hardt and Mikkelsen show that the anaphoric *same* is sensitive to the content of the clause containing the antecedent individual, and this clausal-content sensitivity is not shared by individual pronouns, or definite descriptions, or even the anaphoric

[15] See also Hardt *et al.* (2012) for an earlier version, I take the 2015 paper to be the authors' final words on the empirical landscape.

*different*. They point to three kinds of cases that make an anaphoric *same* infelicitous, but have no effect on ordinary individual pronouns or definite descriptions.

- When the antecedent clause is negated:

(77) John didn't read *War and Peace*$^x$. ...

a. # (But) Mary read the same$_x$ book.

b. Mary read the$_x$ book.

c. Mary read it$_x$.

- When the verbal predicate in the antecedent clause doesn't have a meaning parallel to the predicate in the local clause:

(78) John praised *War and Peace*$^x$. ...

a. # (But) He read the same$_x$ book.

b. Mary read it$_x$/the$_x$ book.

- When the antecedent clause is interpreted as about the same event as the local clause:

(79) John caught a$^x$ big fish. ...

a. # He caught the same$_x$ fish without any fishing equipment.
(# under the same fishing event reading)

b. He caught it$_x$/the$_x$ fish without any fishing equipment.

In addition, they argue that the anaphoric *different* patterns with plain individual anaphora, not *same*. This is surprising because the literature has mostly treated the two adjectives as duals:

- Not sensitive to negated antecedent:

(80) John didn't read *War and Peace*$^x$. ... ✓ Mary read a different$_x$ book.

- Not sensitive to predicate meanings:

(81) John praised *War and Peace*$^x$. ... ✓ He read a different$_x$ book.

Comparing these observations to our data, it's straightforward to see that *same* patterns with amount comparatives in its sensitivity to the clausal level content and *different* patterns with adjectival comparatives. One may reasonably expect that they can be explained, if (i) we extend the correlate-comparison meaning to identity comparatives (cf. Heim 1985) and (ii) *same* behaves like amount comparatives and *different* like adjectival comparatives in terms of possible scope position. I'll show that these can be achieved.

### 2.4.2 Deriving the scope difference

Let's begin by giving *same* and *different* appropriate meanings parallel to scalar comparatives. With the current technical setting, a simple implementation is to give *same* and *different* de-compositional analyses parallel to what's standardly assumed for scalar comparatives. Let *same* and *different* be de-composed into a predicate of identity and a scope-taking comparative marker (cf. Sun 2021 for an analogous analysis of *same*):

(82) IDENT := $\lambda z \lambda x . x = z$

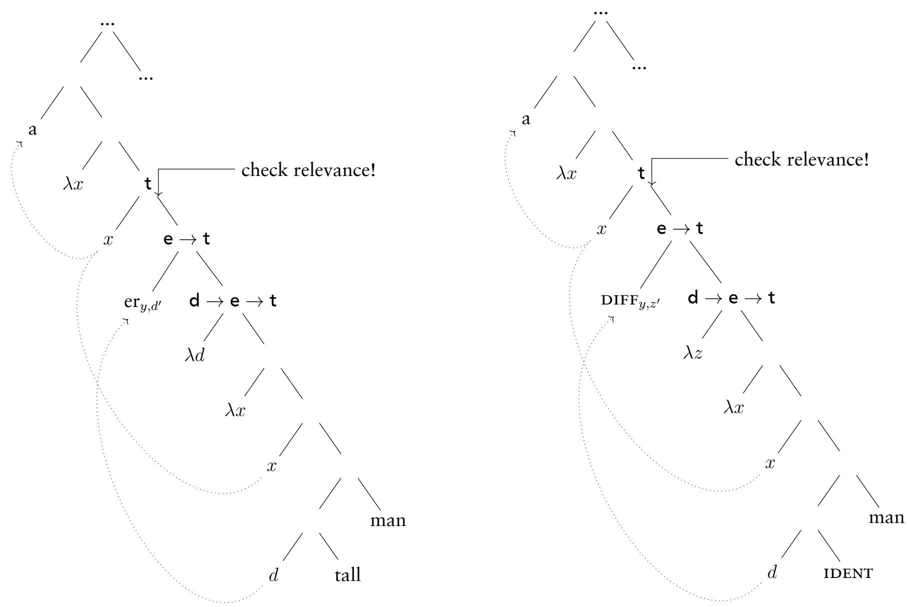
(83) $[\![ \text{same}_{y,z'} ]\!] \rightsquigarrow \text{SAME}_{y,z'}\text{-IDENT}$

a. $\text{SAME}_{y,z'} := \lambda f \lambda x . \underline{z' = \mathsf{max}\{z \mid fzy\}} . \mathsf{max}\{z \mid fzx\} = z'$

(84) $[\![ \text{different}_{y,z'} ]\!] \rightsquigarrow \text{DIFF}_{y,z'}\text{-IDENT}$

a. $\text{DIFF}_{y,z'} := \lambda f \lambda x . \underline{z' = \mathsf{max}\{z \mid fzy\}} . \mathsf{max}\{z \mid fzx\} \neq z'$

On top of these, I propose that we can derive the scope difference between *same* and *different* if we allow the relevance condition on anaphoric resolutions to apply to smaller domains on a syntactic structure. I propose we revise (60) to (85), allow-




(a) scalar comparative (b) identity comparative

Figure 2.4: Checking relevance inside a noun phrase

ing the condition to apply to minimal domains containing free variables that have a propositional-type meaning:

(85) *Resolution to a relevant antecedent*

Co-index expressions $A, B, \ldots$ with free variables $x, y, \ldots$, iff the minimal propositional node $p$ containing $x, y, \ldots$ is that, after the co-indexation, $[\![p]\!]$ is about a salient subject matter. (final version)

The main effect of this revision is that we'll get to check the relevance of the comparative statement even when the comparative marker takes noun phrase internal scope. I give in Figure 2.4 sketches of the relevant part of the structure when relevance is checked inside a noun phrase. Figure 2.4a demonstrates the NP-internal derivation of an adjectival comparative *a taller man*: assuming the determiner that licenses the use of *er* takes scope cyclically and leaves a second trace above *er*[16], the

[16]In the current framing of the analysis, this kind of syntactic derivation is necessary to get the propositional-type node inside the noun phrase. However, it will no longer be required once we recast the analysis in a specialized dynamic framework, in chapter 5.

minimal propositional-type node containing *er*'s free variables is the node immediately C-commanding this second trace. The reader is welcomed to check that the meaning we get at this node is just a comparison between two individuals: the individual that the determiner introduces, and the correlate $y$ that *er* is anaphoric to. According to (85), this is where the relevance condition is applied, we check if this individual comparison could be about any subject matter. In Figure 2.4b is an entirely parallel derivation of *different* taking NP-internal scope, in *a different man*. The meaning of the minimal propositional node containing DIFF's free variables is (86). It is also a comparison between the man introduced by *a* and the correlate $y$ that DIFF is anaphoric to; the comparison dimension (i.e. DIFF's scope argument) is pretty trivial – we can perhaps paraphrase it as *the dimension of being oneself* – and we end up with a roundabout way of saying that these two individuals are different from each other. Again, the anaphoric resolution needs to guarantee that this comparative proposition is about some subject matter, which should be potentially satisfied by any two non-identical men.

(86) $\underline{z' = \mathsf{max}\,\{z \mid y = z \wedge \mathsf{man}\,y\}}.\mathsf{max}\,\{z \mid x = z \wedge \mathsf{man}\,x\} \neq z'$

So far so good, but we encounter problems when the comparative marker of *same*, SAME, attempts to do the same – taking scope in its containing NP. Consider *the same man* for example, the syntactic derivation will be parallel to Figure 2.4b (substituting *a* with *the* and DIFF with SAME), and the meaning of the minimal propositional-type node containing SAME's free variables will be (87): comparing two correlate individuals on the dimension of being themselves and requiring them to be identical.

(87) $\underline{z' = \mathsf{max}\,\{z \mid y = z \wedge \mathsf{man}\,y\}}.\mathsf{max}\,\{z \mid x = z \wedge \mathsf{man}\,x\} = z'$

However, no matter what antecedent correlate we choose, this proposition will always be either a necessity (when the two correlates are identical, as anything in any world is always identical to itself) or a contradiction (when they are different). Propositions of this kind don't provide any information distinguishing among possible worlds, therefore it seems intuitively valid to say that they are never about any genuine subject matters (Lewis 1988). It is because of this, I propose, that the anaphoric *same* is banned from taking scope in its containing NP.

In summary, we can give anaphoric *same* and *different* comparative-style meanings composed of a mapping of identity and a scope-taking comparative marker. Different from *different*, the comparative marker in anaphoric *same* can't take the narrowest NP-internal scope because it always results in pragmatic infelicity.

### 2.4.3 Extend the analysis

*Different* lacks sensitivity to clausal-level content due to the same reason that adjectival scalar comparatives lack it; it's because the comparative marker can optionally take noun phrase internal scope, in which case the semantic content external to the NP is simply out of the scope of the comparison. The derivation of *Mary read a different book*, with DIFF scoping internal to the noun phrase, is shown in (88), entirely parallel to Figure 2.3a. The comparison that results from it is a comparison between two books, followed by a statement that Mary read one of them. The anaphora will not be disrupted as long as there is a salient book antecedent available, hence the acceptable uses in (80) and (81).

(88) $[\,[\,\mathrm{a}^x\,[\,\textsc{diff}_{x',z'}\;\lambda z\lambda x[\,x\;z\text{-}\textsc{ident}\;\mathrm{book}\,]\,]\,]\;\lambda x.[\,\mathrm{Mary\ read}\;x\,]\,]$

a. $\rightsquigarrow \underline{z' = \mathsf{max}\,\{z \mid x' = z \wedge \mathsf{book}\,x'\} \wedge \mathsf{read}(x, \mathsf{mary})}.$
$\exists x : \mathsf{max}\,\{z \mid x = z \wedge \mathsf{book}\,x\} \neq z'$

As I've demonstrated above, anaphoric *same* doesn't have this narrow scope option since it always leads to a proposition that is either a necessity or a contradiction. Thus it is forced to take clausal scope, like the amount comparative, and we can explain the pattern in (77) - (80) in pretty much the same way we have explained the amount comparatives' context dependency.

In (77), we can try to let *same* be anaphoric to the individual *John*; the appropriate interpretation of *John read the same book* is then derived via the LF in (89), generating a comparison between Mary and John on the books they read[17]. Importantly, the understood standard book can't be *War and Peace*, because the negation has denied that this is a book that John has read. We can try other possible correlates, but none of them will bring out a comparison in which *War and Peace* is the understood standard. Thanks to negation, the *War and Peace* can't be identified as the standard that SAME has calculated on its local, positive scope function.

(89) $[\,\text{Mary}^{x,z'}\,[\,\textsc{same}_{x'}\ \lambda x \lambda z\,[\,x\ \text{ read}\,[\,\text{the}^{v}\ z\text{-}\textsc{ident}\,\text{book}\,]\,]\,]\,]$

a. $\rightsquigarrow \underline{z' = \mathsf{max}\,\{z \mid \mathsf{read}(\iota x : x = z \wedge \mathsf{book}\,x, \mathsf{john})\}}.$

$\mathsf{max}\,\{z \mid \mathsf{read}(\iota x : x = z \wedge \mathsf{book}\,x, \mathsf{mary})\} = z'$

The disruption by *read/praise*, or any pair of predicates that is not contextually parallel is also explained in the same way: the meaning parallel feeds the relevance of the comparison, and comparison between the book John read and he praised, as in (78), is not obviously relevant to any identifiable subject matter.

And finally, this relevance condition can also explain the distinct-event requirement exemplified in (79). When it's under the prior sentence and the local comparative sentence is interpreted as describing the same event, there can't be any *differentiating* correlate to compare to. Because if they are the same event, the fish must be caught by the same individual, in the same time and location, using the same tool. Can we make a comparison between a pair of identical correlates, then? No, because comparing two identical correlates on *any* dimension will always result in either necessity or contradiction, and thus – as I've discussed above – pragmatically

[17] The meaning I give to the definite determiner *the* is simply the meaning of an iota operator $\lambda P.\iota x : Px$. It has been a mystery in this literature that the definite determiner in *the same* construction doesn't seem give rise to the definiteness/uniqueness inference it normally does. This is explained by our semantics here: because *same* introduces an identity predicate in the scope of the iota operator, the uniqueness is interpreted relative to an identity, hence is nullified in the broader context. The unique individual which is identical to some individual is just a roundabout way of pointing to *that* some individual.

infelicitous.

In addition to explaining these data, this parallel explanation to negation sensitivity also lends itself to the same possible exemptions we have discussed before. One is when the local function for comparison itself is negative. This works for *same* too: (90) does have a felicitous reading where *same* compares to *War and Peace*; this is especially salient in a context where both John and Mary are supposed to read certain books, and both of them skipped *War and Peace*. The second scenario is when the polarity itself is the comparison parameter. And indeed, we find (91) is acceptable in those contexts where comparing what Mary has read to what John has not read is relevant.

(90) John didn't read *War and Peace*. ... Mary didn't read the same book.

(91) John didn't read *War and Peace*. ... Mary DID read the same book.

### 2.4.4 Theory comparisons

*Parallelism between eventualities*

Hardt *et al.* (2012), Hardt and Mikkelsen (2015), (2019) have developed a theory for anaphoric *same* and *different* on Davidsonnian eventualities. In their theory, the anaphoric *same* is sensitive to a larger linguistic context because it is anaphoric to an eventuality. *Different*, on the other hand, is only anaphoric to an individual.

Take *John read War and Peace, ... Mary read the same book.* for example, the first sentence introduces an event variable into the DRS box; call it $e_3$ (92). The second sentence also introduces an event variable, and *same* is co-indexed with both event variables, imposing a parallel condition (in the sense of Kehler 2002) on these two events. Roughly, the interpretation of the second sentence comes out as (93)[18].

[18] In Hardt and Mikkelsen (2015), the identity condition of between the two individuals, i.e. $u_5 = u_2$ in (93), is imposed by the definite determiner *the*. In Hardt and Mikkelsen (2019) this condition is part of the meaning of *same*, and the parallel constraint on the two events is characterized as a presupposition. For our purposes here, these differences won't matter.

(92) $[u_1, u_2, e_3 \mid u_1 = \textsf{john}, u_2 = \textsf{wp}, e_3 : \textsf{read}(u_2, u_1)]$

(93) $[u_4, u_5, e_6 \mid u_1 = \textsf{mary}, u_5 = u_2, e_6 : \textsf{read}(u_5, u_4), \textsf{parallel}(e_3, e_6)]$

Sensitivity to negation in (77) is accounted for by the fact that negation blocks the discourse potential of events introduced in its scope – so the intended antecedent, i.e. John's reading event – will no longer be an accessible antecedent for *same* in the second sentence. The infelicity in (78) and (79) are both results of failing to satisfy the parallel condition: two events are parallel to each other if they are distinct events and we can infer a non-trivial common theme between them.

I believe that my theory has some advantages compared to this event-based account.

First, there aren't obviously parallel events in utterances like (94). What are parallel in (94) is the relation between Mary and her cap and the relation between the man in the second sentence and his cap, so for *same* to impose its parallel condition, we must say that an event variable is introduced in the noun phrase *a man with the same cap* (cf. Barker 2007, Hardt and Mikkelsen 2015), which deviates from the standard assumption that event variables are introduced by verbs.

(94) Mary is wearing a red baseball cap. ... A man with the same cap came in.

Second, in the event-based account, there is no obvious motivation for *same* to take scope. In fact, the lexical meanings given in Hardt and Mikkelsen (2015) and (2019) explicitly suggest *same* is interpreted *in-situ*. As such, there should be no locality constraints, anaphoric *same* should be possible when it can be bound by the two eventualities it compares. But as documented in Hardt *et al.* (2012), we observe that the anaphoric reading is impossible when *same* is trapped inside a scope island.

(95) exemplifies the *wh*-clause island: moving *what* across the embedded *why*-clause is not acceptable. in (96), we see that when *same* is trapped in the embedded *wh*-clause, the anaphoric reading is also unavailable.

(95) # What$_i$ did John knows why Mary read $t_i$?

(96) John knows why Mary read *War and Peace*. ... # Harry knows why Mary read the same book.

Why (96) is bad is left unexplained in the event-based account, since *same* can be bound by the two matrix events, i.e. John and Harry's knowing, hence should be able to compare these two events. In contrast, my theory can attribute the infelicity of (96) to the same reason that (95) is bad. In my account, *er* in (96) has to take scope immediately under its licensor; in (96), since the licensor is the matrix subject, it would require *er* to take scope over the embedded *wh*-clause, which we have seen in (95) is not possible.

The following examples show the effect of a number of other well-known island constraints. In each of these examples, *same* and its licensor are separated by an island barrier and the intended anaphoric reading is not available.

- Complex NP island

  (97) John rejected the claim that Mary read *War and Peace*. ... # Harry rejected the claim that Mary read the same book.

- Sentential subject island

  (98) That Mary read *War and Peace* bothers John. ... # That Mary read the same book bothers Harry.

- Adjunct island

  (99) John laughed when Mary read *War and Peace*. ... # Harry laughed when Mary read the same book.

Taking a step beyond *same* and *different*, my account also has the advantage of providing a uniform view for anaphoric comparatives. All kinds of comparatives consist of a scope-taking comparative marker, and all comparatives are only different from each other in (i) what the comparison dimension (i.e. the scale) is and (ii) what ordering relation is imposed by the comparative marker. The seeming differences between amount vs. adjectival comparatives and *same* vs. *different* are due to the scope position of the comparative marker, which is either independently motivated or can be derived from general discourse principles.

Generalizing the event-based account to scalar comparatives is possible, but it would be necessary to say that certain comparative lexical items impose event parallelism (e.g. *same* and amount comparatives) while others don't. Apart from being stipulative, this two-way distinction won't be enough to explain lexical items that pattern with *same/more* in *some* but not all respects. For example, the anaphoric use of *equally long* is not sensitive to negation, unlike *same* – (100) has a perfectly natural reading where the standard degree of *equally long* is the length of *War and Peace*; it is, however, clearly sensitive to the distinctness condition, which would explain why (101) yields a distinct-event reading just as (79). The felicity of (100) suggests *equally long* doesn't impose event parallelism, but if it doesn't, (in this account) we will need yet another constraint to rule out the same-event reading in (101).

(100) John didn't read *War and Peace*, but he read an equally long book.

(101) John caught a big fish, and he caught an equally long fish without any fishing equipment.

In contrast, my theory naturally predicts this mixed pattern. *Equally long* isn't sensitive to negation because it takes an adjectival measure (long), thus the equative marker is free to take narrow scope in its containing, just like adjectival comparatives are. When taking this narrow scope, *equally* is only anaphoric to the individual book wp in (100). On the other hand, the same event reading in (101) is expected to be impossible, because it would require a comparison between two identical correlates, resulting in a pragmatically infelicitous proposition.

*Incorporating sensitivity to focus alternatives*

Hardt *et al.* (2012) also likens the context dependency of anaphoric *same* to that of the focus-sensitive, additive particle *too*. In Hardt and Mikkelsen (2021) the idea is developed into a detailed implementation.

Their basic claim is *same* and *different* incorporate *too* in their lexical meanings:

(102) Definedness condition of $too_m$:

Let $\phi$ be an LF, then, for some context $c$, $c + [\![ \text{too}_m ]\!]([\![\phi]\!]) := c + [\![\phi]\!]$ iff the LF co-indexed with *too*, $\psi^m$, is such that:

a. $[\![ \psi ]\!] \neq [\![ \phi ]\!]$

b. $[\![\psi]\!] \in [\![ \phi ]\!]^{\text{f}}$

c. $c + [\![ \psi ]\!] = c$ (i.e. $[\![ \psi ]\!]$ is true in $c$)

else undefined. (cf. Singh 2008)

(103) $[\![ \text{same}_{m,n} ]\!] \rightsquigarrow \text{too}_m\ \textsc{ident}_n$

a. $\textsc{ident}_n := \lambda x.x = g_n$

(104) $[\![ \text{different}_{m,n} ]\!] \rightsquigarrow \text{too}_m\ \textsc{not-ident}_n$

a. $\textsc{not-ident}_n := \lambda x.x \neq g_n$

*Too* takes scope[19]. In the utterance *John read War and Peace, ... Mary read the same book*, it takes scope over the containing clause, and its antecedent would be the LF of the first sentence (105). Assuming *Mary* and *the* $\textsc{ident}_n$ *book* are focus-marked, the containing clause has the focus value in (106). All definedness conditions of *too* are satisfied: the antecedent meaning $[\![$ John read *War and Peace* $]\!]$ is distinct from the literal meaning of the containing clause but part of its focus value, and true in the local context of *too*.

(105) [ John read *War and Peace*$^n$ ]$^m$, ...[ $\text{too}_m$ [$\text{Mary}_\text{F}$ read [the $\textsc{ident}_n$ book]$_\text{F}$ ] ]

[19]For the theory to work as intended, *too*'s scope-taking shouldn't result in lambda abstraction.

(106) $[\![\, \text{Mary}_{\text{F}}\ \text{read}\ [\ \text{the}\ \textsc{ident}_n\ \text{book}\ ]_{\text{F}}\, ]\!]^{\text{f}} := \{[\![\, x\ \text{read}\ y]\!] \mid [\![x[\![\in \mathcal{D}_{\mathsf{e}}, [\![y]\!] \in \mathcal{D}_{\mathsf{e}\to\mathsf{t}\to\mathsf{t}}\}$

The *too* in *different* can take clausal scope as in (105), but it can also take narrow scope, attaching to a noun phrase (107); when it does, the two antecedents of the comparative coincide: *too* is anaphoric to the LF of *War and Peace* and NOT-INDENT is anaphoric to its referent wp. The authors propose that this narrow scope option is unavailable for *same* because when it attempts to do the same, as in (108), the antecedent of *too* is identical to the referent of *the* IDENT$_n$ *book*, violating the distinctness condition in (102a).

(107) [ John read *War and Peace*$^{n,m}$ ], ...[ too$_m$ [ [a NOT-IDENT$_n$ book]$_{\text{F}}$ ] ]

(108) [ John read *War and Peace*$^{n,m}$ ], ...[ too$_m$ [ [the IDENT$_n$ book]$_{\text{F}}$ ] ]

*same* is sensitive to a larger context because its *too* is obliged to take the wider scope and thus sensitive to a broader focus domain. In the problematic utterance of (77), we could give *same* the same antecedents as in (105) (see (109)), but the meaning of the antecedent LF is not true in *too*'s local context, thanks to the negation. The use of the anaphoric *same* is infelicitous because there is no possible antecedent of *too* that satisfies *too*'s definedness conditions. The infelicity in (78) and (79) are attributed to the failure of having appropriate focus alternatives and satisfying the distinctness condition.

(109) [ not [ John read *War and Peace*$^n$ ]$^m$ ], ...[ too$_m$ [Mary$_{\text{F}}$ read [the IDENT$_n$ book]$_{\text{F}}$ ] ]

There are some technical details not entirely worked out up to the time of this dissertation. For example, for the theory to work as intended, it is important to guarantee that the antecedent of IDENT/NOT-IDENT is not from outside the antecedent of *too*, otherwise we predict *John didn't read War and Peace*, *Mary read Persuasion, and Sue read the same book* could have a felicitous reading that says Mary read the book *War and Peace*, with *too* being anaphoric to *Mary read Persuasion*.

The main issue of this implementation, though, is that while focus plays the central role, it is not clear that the focus pattern in anaphoric identity comparatives is, or can be, exactly what the theory requires. For starters, empirically it isn't obvious that in *Mary read the same book*, the subject needs to be bearing any stress; if so we would need to treat focus marking as some kind of syntactic feature not correlated with stress marking. More importantly, that the focus alternatives the narrow scope *too* inspects can be a set of noun phrase meanings (107) is vitally important to derive the narrow scope possibility, which is what explains the difference between *same* and *different*. Yet this makes the condition of truth of *too* inapplicable – truth applies to propositions, not to entities or generalized quantifiers, it is therefore unclear how the condition in (102c) can be defined when $\psi$ is a noun phrase.

### 2.5 More on the locality constraints

Scope-taking is at the core of my theory. All comparative markers need to take scope immediately under its licensor in order to obtain the targeted measurement relation between degrees and comparison correlates, thus all anaphoric comparatives might be bound by locality constraints. However, testing those island constraints on comparatives other than *same* turns out to be a tricky business.

*Amount comparatives*

In (110), with the apparent licensor of the comparative being the matrix subject *Harry*, we expect the covert movement of *er* to a position immediately under *Harry* to be disrupted; but (110) sounds quite sensible.

(110) John wonders why Mary read ten books. ... Harry wonders why Mary read more.

I think there is an orthogonal reason that (110) could be sensible for. It is possible that the embedded tense in these two sentences denotes different time intervals: e.g. John wonders why Mary read ten books (last month), and Harry wonders why Mary read more (in the last and this month). If so, we can get this reading, not by comparing the matrix subject, but by comparing the embedded tense; in that case, *er* never needs to take scope outside the embedded *wh*-clause.

We can use an overt temporal adverb to rule out this irrelevant interpretation:

(111) John wonders why Mary read ten books in her entire life. ... Harry wonders why Mary read more (in her life).

Yet we face other confounding factors in (111). An embedded question *whyp* implies that the proposition *p* is true at least in (some) belief worlds of the wonderer, so (111) implies that John believes that Mary read ten books in total and Harry believes she read more. The comparison of *more* could easily be between Harry's belief world and John's belief world.

Apart from temporal and world variables, in (112) it is possible for *er* to compare the variable bound by the covert *wh*-operator standardly assumed in relative clauses. This would derive a comparison between the claim Harry rejected and the claim John rejected.

(112) John rejected the claim that Mary read ten books. ... Harry rejected the claim that Mary read more.

We see essentially the same issue again and again in these testing examples: while the apparent licensor of the comparative is outside the island, it is always possible to find a contrasting variable in the proposition embedded in the island, leaving the possibility of *er* taking narrow scope open.

The root problem, I think, is that eliminating all potential contrasts in the proposition embedded in the island containing *more*, as in (113), would result in a contradiction, i.e. a certain amount is simultaneously a certain number and more (e.g. in (113), Mary's reading amount in her lifetime in the real world is simultaneously ten and more). This is clearly different from *same*, e.g. (114) induces no contradiction.

(113) That Mary **actually** read ten books **in her entire life** bothers John. ... # That Mary (actually) read more books (in her life) bothers Harry.

(114) That Mary **actually** read *War and Peace* **in today's class** bothers John. ... # That Mary (actually) read the same book (in today's class) bothers Harry.

The consequence is two-fold: possibly this contradiction makes the interpreter lean to a narrow-contrasting parsing in above examples with *more* (110) - (112), more readily than with *same*; on the flip side, sentences like (113) where the possibility of narrow-contrasting is ruled out also can't be taken as evidence for *er*'s island violations, because the infelicity could be due to the contradiction. In the end, we just can't seem to find a good test for the island effects on anaphoric amount comparatives.

*different and adjectival comparatives*

Applying the island tests in (115) - (118) on *different* and adjectival comparatives also doesn't yield infelicity, they all have a felicitous reading comparing to the book mentioned in the first sentence. However, in none of these sentence does *different/more interesting* need to take scope outside the island – it can always take narrow scope inside its containing NP, deriving a comparison to the book *War and Peace* directly.

(115) John knows why Mary read *War and Peace*. ... Harry knows why Mary read a different/more interesting book.

(116) John rejected the claim that Mary read *War and Peace*. ... Harry rejected the claim that Mary read a different/more interesting book.

(117) That Mary read *War and Peace* bothers John. ... That Mary read a different/more interesting book bothers Harry.

(118) John laughed when Mary read *War and Peace*. ... Harry laughe when Mary read a different/more interesting book.

One may try to force the comparative to associate with the matrix clause licensor, by making the book antecedent inaccessible. In (119), the indefinite *a book* won't be an accessible discourse antecedent for the comparative if it doesn't have the wide scope reading of denoting a specific book, and (119) does seem uninterpretable with the narrow scope indefinite. Nevertheless, we can't be certain this is caused by the island violation. The reading we are after is that John knows why Mary read a book which is different from/more interesting than *any* book that Mary read and John knows why she did[20], but this is impossible because the narrow-scope indefinite in the first sentence gives rise to the inference that for *every* book Mary read, John knows the reason. So the targeted reading might be unavailable because of this contradiction.

(119) John knows why Mary read a book. ... # Harry knows why Mary read a different/more interesting book.

I conclude that anaphoric *different* and adjectival comparatives can't be tested on whether they are structurally bounded either.

*Summary and lookout*

For comparatives other than *same*, the predicted locality constraints can't be observed on their anaphoric reading. For the different reasons that I have discussed, it appears impossible to guarantee the comparative marker associates with an island-external licensor, without causing a contradictory reading.

It is worth noting that the underlying issue , i.e. that we can't directly see exactly which variable is being compared by the comparative, is one pertaining to the anaphoric reading. In the generalized comparative semantics to be developed, this is no longer the case for other uses of comparatives. And indeed, researchers have

[20]This involves having degree maximization over the indefinite, which is technically banned from the so-called Heim-Kennedy constraint (Kennedy 1997, Heim 2000) in the current framework. However, it is empirically attested that we can get a *more than any* reading when an indefinite is in the standard clause (e.g. *My apartment is closer to a train station than to an airport.*), plausibly by maximizing over an indefinite. See more discussions on this in chapter 3.

noted island effects in those other uses:

- Explicit comparatives

(120) * Someone who could answer more questions made a good impression on Bill than on Fred. Heim 1985: ex. (36)

- The internal reading

(121) * Everyone knows why Mary read a different book.
(* under the reading that the book everyone knows about is different from each other)

We will understand these violations more after building a concrete theory for explicit comparatives and the internal reading, in chapter 3 and 5 respectively.

### 2.6 Chapter wrap-up

In this chapter, I have argued that the anaphoric use of comparatives is better explained in an approach modeling the comparative meaning as comparisons between correlates, rather than directly ordering bare degrees.

I have explained, in section 2.2, that while comparatives with a contextually supplied standard are clearly anaphoric, the nature of their antecedent is less than clear. The null hypothesis following the standard approach to comparative semantics is that the comparative is anaphoric to a salient degree in those cases. I have shown that this is falsified by the differences between anaphoric amount comparatives and anaphora to amount degrees: the former, but not the latter, is further constrained by semantic content on the clausal level, including polarity and predicate meaning, even in the presence of accessible and salient degree antecedents. An alternative ellipsis-based theory is considered, but is eventually shown to be not very helpful.

In section 2.3, I have presented a re-analysis of anaphoric *er*. The re-analysis, building on a little twist of the direct analysis of phrasal comparatives, has *er* anaphoric to a (series of) correlates and a standard degree, with a definedness constraint that the degree is the measurement of those standard correlates on the locally derived measurement function. Therefore, the standard (as well as the target) degree is constrained by this function, i.e. the scope of the comparative marker. This, combined with the widely accepted assumption that the amount comparative *er* obligatorily scopes at the clausal level, can predict its sensitivity to the clausal level content in the anaphoric use.

I have also considered the implications of the proposal in a broader context. Identity comparatives *same/different* can be used anaphorically, too, and the context dependency of *same* exhibits similar patterns with anaphoric amount comparatives. Therefore in 2.4 I extend the proposal to identity comparatives, showing that the proposal can provide a uniform view on anaphoric comparatives in general. I also argued that my account has advantages compared to previous analyses on the *same/different* data, one of them is that it correctly predicts the island constraints of *same*. In section 2.5, I have also addressed why the predicted island effect are not as easily observed on other comparatives.

In sum, using data from anaphoric comparatives, this chapter provides a first argument for the new approach to comparatives that compares alternatives (i.e. correlates), as opposed to random degrees.

# CHAPTER 3
# COMPARATIVE AMBIGUITIES

## 3.1 Introduction

This chapter presents another application of the correlate-based comparison meaning. The empirical phenomenon concerns the recurrent ambiguities between comparison, additivity, and continuation (henceforth *CAC ambiguities*). Descriptively speaking, these are the meanings expressed by the bolded word in the following sentences respectively. Following Thomas (2018), I will call these words CAC operators.

(122) John is **more** intelligent than Kim. (Comparison)

(123) Mary bought two apples. John bought one **more**, in addition to what she bought. (Additivity)

(124) It's 7 o'clock in the morning, John is **still** asleep. (Continuation)

CAC operators that can give rise to more than one of these meanings are repeatedly attested in a wide range of languages, which suggests a logical connection between the three meanings. Formalizing this connection within the traditional approach to comparatives is less than straightforward, though some progress has been made by appealing to abstract entities (e.g. events, scale segments) in the semantic representation of comparatives. In this chapter, I will show that when we reconceptualize the comparative meaning as a comparison between correlates, the recurrent CAC ambiguities can receive a fully compositional account with a better empirical coverage.

I will introduce the empirical pattern in greater detail in section 3.2. The formal analysis is presented afterward, in section 3.3. We will see that the simple static version of the analysis proposed in chapter 2 suffices to explain most of the data.

Section 3.4 compares the proposal with previous works on CAC operators. Section 3.5 concludes.

## 3.2 Data

### 3.2.1 Cross-linguistic ambiguities

Sentences like (125) are ambiguous. In its first interpretation, *more* intuitively expresses a strictly exceeding relation between the apples John bought and the apples Mary bought; the second sentence is true iff John bought eight apples – three more than Mary. In the second interpretation, the second sentence is true iff John bought three apples *in addition to* the apples that Mary bought. This is the additive reading of *more*.

(125) Mary bought five apples. ... John bought three more apples.

That a sentence with anaphoric *more* is truly ambiguous between the two readings can be shown by the fact that, in certain contexts, it is false under one reading and true under another. Consider, for instance, example (126), where the sentence is uttered in contexts (126a) and (126b):

(126) Twenty people died in the church bombing, and ten more people died in the school bombing.

a. Thirty people died in the school bombing.

b. Ten people died in the school bombing.

Thomas (2018): ex. (7)

In the context of (126a), the sentence is true under the comparative reading and false (or infelicitous) under the additive reading; in the context of (126b), the sentence is true under the additive reading and false under the comparative reading.

The additive reading is *only* licensed in the anaphoric use of *more*. It is blocked by the use of an overt standard clause. In the following sentences (127) – (128) with an overt *than*-clause, the additive reading where John only bought three apples is gone:

(127) John bought three more apples than Mary did.

(128) Mary bought five apples. John bought three more apples than that.

This additive interpretation of the comparative word – *more* and its cross-linguistic counterparts – in its anaphoric use is attested in a variety of languages, including (at least) Spanish, Brazilian Portuguese, Guarani, and French. In all of these languages, the ambiguity is blocked by the overt presence of the standard marker, just like in English (Thomas 2018). For example, (129) demonstrates the ambiguity in French: the first sentence (129a) must be interpreted additively, as the follow-up headline makes clear; in the second sentence (129b), the overt standard phrase *que l'an dernier* is present, and the sentence can only be interpreted comparatively.

(129) *French*

a. Ce week end, deux morts de plus sur les routes. Samedi, deux
   This week end two death of more on the roads Saturday two
   homees sont morts sur les routes sarthoise.
   men are dead on the road sarthoise.

   "This weekend, two more deaths on the roads. On Saturday, two men died on the roads of the Sarthe. "

b. Onze morts de plus que l'an dernier sur les routes.
   Eleven death of more than the.year last on the roads.

   "Eleven more deaths than last year on the roads. "

Thomas 2018: ex. (21)

Another widely attested ambiguity is between additivity and continuation. German is an example of this class. The German particle *noch* has an additive reading exemplified in (130a): the sentence conveys that Otto drank a Schnapps, presupposing that he had drunk Schnapps before. In some other contexts, the same particle expresses the continuation of an event from an earlier time, e.g., in (130b) it conveys that the raining has continued from past to present. Other languages such as Italian (*anchora*) have been reported to have the same ambiguity too (Tovena and Donazzan 2008, Thomas 2018).

(130) *German*

a. Otto had noch einen Schnapps getrunken.
   Otto had *noch* one Schnapps drunk
   "Otto had another Schnapps."

b. Es regnet noch.
   It raining *noch*
   "It is still raining."

There are also languages that exhibit a three-way ambiguity. For example, the Romanian particle *mai* can be used to express comparison, additivity, and continuation, as exemplified in (131).

(131) *Romanian*

a. Ion e mai inteligent decât Petre
   John is *mai* intelligent than Petre
   "John is more intelligent than Petre." comparison

b. Ion va mai citi un roman.
   John AUX *mai* read a novel.
   "john will read another novel." additivity

c. Ion mai merge la bibioteca⍰.
   John *mai* goes at library
   John still goes to the library. continuation

Donazzan and Mardale (2010): ex. (4), (30b), (36)

Moreover, while there are also languages that exhibit ambiguity between additivity and comparison to the exclusion of continuation (e.g., English *more*), languages that exhibit ambiguity between additivity and continuation to the exclusion of comparison (e.g., German *noch*), as well as languages that exhibit no ambiguity between these three meanings (e.g., Vietnamese), there appears to be no language that can have ambiguity between comparison and continuation to the exclusion of additivity. In other words, we observe the following implicational universal:

(132) If a morpheme in a language exhibits ambiguity between comparison and continuation, it must also have an additive interpretation.

These above observations strongly suggest the repeated ambiguities are no accident; there must be a logical connection between the meaning of comparison, additivity, and continuation.

### 3.2.2 Variable scales for continuation

Multiple previous studies on the additive *more* notwithstanding (Greenberg 2010, Thomas 2011, Feldscher 2017 & 2019), Thomas (2018) is, as far as I know, the first and only account that explains the three-way logical connection between comparison, additivity, and continuation.

Continuative meanings are associated with a pre-determined scale, and one of Thomas' key insights is that the scale can be derived as a presupposed comparison. His translation of temporal continuation in *it is still raining* can be roughly paraphrased as (133)[1], in which the scale is derived as the presupposed comparison between two events on their stage of development (see Landman 1992 for more on the stage of event): there is a raining event $e$ whose running time contains the current time, presupposing that the summation of $e$ and an alternative, antecedent event $g_1$ is a more developed event than $e$ itself (see Ippolito 2007 for a similar characterization). Given that we can naturally assume that events always develop towards later times, the presupposition is equivalent to that the raining event $g_1$ is an earlier event, started earlier, i.e. it was raining earlier.

[1] In Thomas's paper, presupposition is formally represented using Beaver and Krahmer's partiality operator $\partial$.

(133) *It is still raining.* $\rightsquigarrow$

$\exists e$ : rain $e \wedge$ pres $\subseteq \tau(e) \wedge \underline{g_1 \oplus e \text{ is a more developed event than } e}$

However, the presupposed comparison on event development is baked into the meaning of a continuative particle like *noch/still* in Thomas' account (see more about this in section 3.4.3) and this has an unpleasant consequence. These continuative operators robustly give rise to meanings that are associated with a variety of different scales, but the account is not flexible enough to explain scales that are not temporal or obviously event-related.

For example, both the German sentence in (134) and its English translation have a most salient non-temporal reading, which presumes a scale that ranks people on their heights: it conveys that there are other people taller than Anthea. Similarly, (135) has a salient reading that should be associated with a scale on spatial locations. The typical context of this sentence seems to presume a path that draws from a place in England to somewhere outside of England, and it implies that some other places also in England are closer to the starting point.

(134) Anthea ist noch gross.
Anthea is *noch* tall
"Anthea is still tall. "

(135) Durham liegt noch in England.
Durham lies *noch* in England.
"Durham is still in England." Beck (2020): ex. (3a) - (3b)

These readings of (134) - (135) are the so-called *marginal readings* of continuation. Notably, the scale presumed in neither of the marginal readings can be naturally paraphrased using the paradigm in (133), as it is unclear what the more developed event is. It seems much more straightforward to conclude from these examples that the scale associated with a continuative sentence can vary, and the scales in these sentences are on things other than times or events (e.g., heights, locations).

That the marginal reading of continuation can be associated with variable scales is further corroborated by the fact that, sometimes, the same sentence can give rise to more than one reading associated with different scales. For example, in (136) - (137), both the German sentence and the English translation have at least two readings: one associated with a scale ranking people on how easily I can explain exercise two to them, which is most salient when *Peter* bears focus (136), and one associated with a scale ranking exercises on how easily I can explain them to Peter, which is salient when *two* is focused (137).

(136) Ich kamn em PETER Aufgabe zwei noch eären.
I can the.Dat Peter exercise two still explain.
"I can still explain exercise two to PETER – Paul is beyond my help. "

(137) Ich kamn em Peter Aufgabe ZWEI noch eären.
I can the.Dat Peter exercise two still explain.
"I can still explain exercise TWO to Peter – exercise three is too hard. "

Beck (2020): ex. (126)

Historically, variable scales and the putative sensitivity to focus exhibited in (136) - (137) are the main issues about particles like *noch/noch*. However, none of the relevant discussions addresses the logical connections between continuation, comparison, and additivity.

## 3.3 The Proposal

In what follows, I will show that it is possible to fill in the gap between the two threads of literature, using the re-analysis of comparatives developed in previous chapters. For the most part, we will use the static version of the analysis proposed in chapter 2, since it suffices to show how additivity and continuation can be derived from comparison. The interaction with the overt standard marker, however, can only be accounted for by the dynamic version of the analysis; I leave it to the next section.

### 3.3.1 The three-way logical connection

Additive *more*: alternative summation

In the analysis developed so far, *more* in (138) compares two alternative individuals, John and Mary. We have seen in chapter 2 how to derive a reading that says the amount of apples John bought exceeds that of Mary. This is the standard, comparative reading.

(138) Mary bought five apples. ... John bought more (apples).

I propose that the additive reading of (138) involves the summation of the two correlates under comparison. In other words, it can be paraphrased as *the apples John and Mary bought exceeds the amount of apples Mary bought*, which correctly predicts that the truth condition of the additive reading is that John bought apples in addition to Mary's purchase.

We can implement this using the simple, static analysis of *er* proposed in Chapter 2 (139). Let's insert an additive operator right above the scope position of $\mathsf{er}_{d',y}$. This operator $\mathsf{ADD}_y$ is defined in (140): it is co-indexed with the implicit correlate argument of $\mathsf{er}_{d',y}$, and applies the relation that *er* returns to the summation of the two correlates, $x \oplus y$, as opposed to the target correlate $x$ alone. As the detailed semantic composition in Figure 3.1 shows, we get the desired reading at the top node: a comparison between the summation of John and the alternative person $y$, i.e., Mary in the context of (138), and $y$ herself, on the amount of apples they bought.

(139) $\mathsf{er}_{d',y} := \lambda f \lambda x.\underline{d' = \mathsf{max}\,\{d \mid fdy\}}.\mathsf{max}\,\{d \mid fdx\}$ $\qquad (\mathsf{d} \to \mathsf{a} \to \mathsf{t}) \to \mathsf{a} \to \mathsf{t}$

(140) $\mathsf{ADD}_y := \lambda f \lambda x.f(x \oplus y)$ $\qquad (\mathsf{a} \to \mathsf{t}) \to \mathsf{a} \to \mathsf{t}$

Continuation: presupposed additive comparison

We can derive continuation from additive comparison by adding another operator:

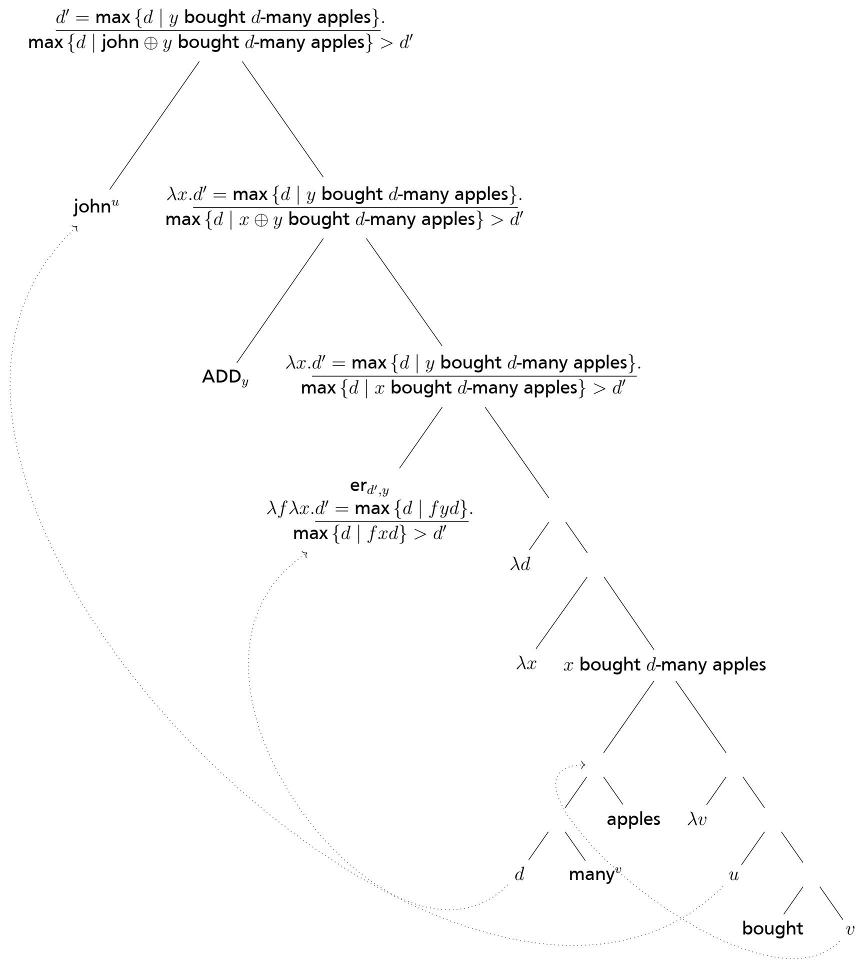



Figure 3.1: Deriving the additive reading of *John bought more apples*

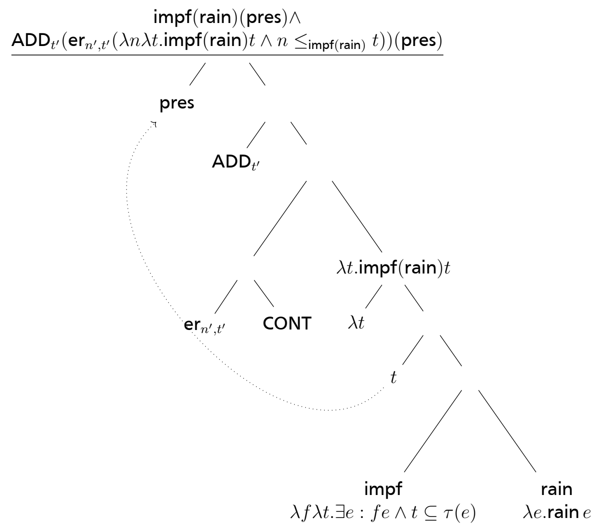



Figure 3.2: Deriving temporal continuation in *it is still raining*

(141) CONT := $\lambda P \lambda f \lambda Q \lambda u.fu \wedge \underline{Q(P(\lambda n \lambda u.fu \wedge n \leq_f u))(u)}$

$$n \leq_f u := fu \models_c fn$$

for any two propositions $p, q : p \models_c q$ iff $\forall w$ in $c : pw \rightarrow qw$

$$((\mathsf{d} \rightarrow \mathsf{a} \rightarrow \mathsf{t}) \rightarrow ((\mathsf{a} \rightarrow \mathsf{t})) \rightarrow (\mathsf{a} \rightarrow \mathsf{t}) \rightarrow ((\mathsf{a} \rightarrow \mathsf{t}) \rightarrow \mathsf{a} \rightarrow \mathsf{t}) \rightarrow \mathsf{a} \rightarrow \mathsf{t}$$

How this works can be illustrated with an example. The meaning of *it is still raining/es regnet immer noch* is derived by letting the present tense take scope and inserting CONT above its abstraction node, as shown in Figure (3.2) (I will assume the expletive *it is* in *it is raining* is semantically null).

Let's examine the meaning we get at the top node more closely. The first part of the meaning is an assertion, which is simply the aspectual predication of the tense: there is a raining event and the present time is within the running time of this event.

(142) impf(rain)(pres) = $\exists e$ : rain $e \wedge$ pres $\subseteq \tau(e)$

The second part of the meaning is a presupposed additive comparison, spelt out in more detail in (143a). This comparison between the summation of the present time and the alternative time $t'$ and $t'$ alone, and its truth conditions can be further divided into two parts. Part one is $\textsf{impf}(\textsf{rain})t'$ and $\textsf{impf}(\textsf{rain})(\textsf{pres}\oplus t')$, i.e., both the present time and the alternative time $t'$ are in the duration of a raining event. This gives rise to the inference that the raining has never stopped in between. The second part is the imposed ordering relation, which amounts to $\textsf{max}\left\{n|n \leq_{\textsf{impf(rain)}} (t \oplus t')\right\} > \textsf{max}\left\{n|n \leq_{\textsf{impf(rain)}} t'\right\}$. Because $n \leq_f u$ is only an abbreviation of $fu \models_c fn$ (i.e., $n$ is a no-stronger alternative to $u$ on a given predicate $f$ iff $fu$ contextually entails $fn$), the imposed ordering translates to $\textsf{max}\left\{n|\textsf{impf}(\textsf{rain})(\textsf{pres} \oplus t') \models_c \textsf{impf}(\textsf{rain})n\right\} > \textsf{max}\left\{n|\textsf{impf}(\textsf{rain})t' \models_c \textsf{impf}(\textsf{rain})n\right\}$, i.e., the maximal time such that its being in the duration of a raining event is entailed by both pres and $t'$ are within the duration of a raining event exceeds the maximal time whose being in the duration of a raining event is entailed by $t'$ is within the duration of a raining event. Since for any time $t$, $t$ being in the duration of a raining event can only entail times that are subintervals of $t$ are also in the duration of a raining event, this comparison reduces to a comparison between the maximal subintervals of $\textsf{pres} \oplus t'$ and of $t'$. Given that the inherent ordering on times is the precedence relation, this then means the maximal subinterval of $\textsf{pres} \oplus t'$ is a later time than $t'$ alone, which is only true if $t'$ is an earlier time than pres. Putting the two parts of truth conditions together, what's in the presupposition is that the raining continues from a past time $t'$ to the present time (143b).

(143) $\textsf{ADD}_{t'}(\textsf{er}_{n',t'}(\lambda n \lambda t.\textsf{impf}(\textsf{rain})t \wedge n \leq_{\textsf{impf(rain)}} t))(\textsf{pres})$

a. $= \textsf{ADD}_{t'}(\lambda t.\underline{n' = \textsf{max}\left\{n|\textsf{impf}(\textsf{rain})t' \wedge n \leq_{\textsf{impf(rain)}} t'\right\}}.$
$\textsf{max}\left\{n|\textsf{impf}(\textsf{rain})t \wedge n \leq_{\textsf{impf(rain)}} t\right\} > n')(\textsf{pres})$
$= (\lambda t.\underline{n' = \textsf{max}\left\{n|\textsf{impf}(\textsf{rain})t' \wedge n \leq_{\textsf{impf(rain)}} t'\right\}}.$
$\textsf{max}\left\{n|\textsf{impf}(\textsf{rain})(t \oplus t') \wedge n \leq_{\textsf{impf(rain)}} (t \oplus t')\right\} > n')(\textsf{pres})$
$= \underline{n' = \textsf{max}\left\{n|\textsf{impf}(\textsf{rain})t' \wedge n \leq_{\textsf{impf(rain)}} t'\right\}}.$
$\textsf{max}\left\{n|\textsf{impf}(\textsf{rain})(\textsf{pres} \oplus t') \wedge n \leq_{\textsf{impf(rain)}} (\textsf{pres} \oplus t')\right\} > n'$

b. $\rightsquigarrow \exists e : \textsf{rain}\, e \wedge (\textsf{pres} \oplus t') \subseteq \tau(e) \wedge t' \prec \textsf{pres}$

Putting them together, the entailed meaning we have derived is essentially (144). I will assume that presuppositions are generally checked in their local contexts, and that for a given conjunction $p \wedge q$, the local context of $q$ is the context updated by $p$ (Heim 1990). The result is the presupposition in the right conjunct doesn't project to the matrix level if it is provided in the asserted content of the left conjunct; e.g., *There is a King of France, and the King of France is bald* as a whole no longer presupposes there is a King of France. Applying this to our case, part of the presupposed additive comparison, namely that it is raining now, doesn't project to the matrix level because it has been directly asserted by the left conjunct. So at the end of the day, *that it is raining* is still the asserted content, and the entailed meaning of the whole sentence contains both new/asserted information (144a) and old/presupposed information (144b).

(144) $[\![\text{it is still raining}]\!] \rightsquigarrow$

$$\exists e : \textsf{rain}\, e \wedge \textsf{pres} \subseteq \tau(e) \wedge \underline{\exists e : \textsf{rain}\, e \wedge (\textsf{pres} \oplus t') \subseteq \tau(e) \wedge t' \prec \textsf{pres}}$$

a. Assertion: it is raining now.

b. Presupposition: the raining has continued from an earlier time $t'$.

In addition to these entailments, it has been argued before that *it is still raining* also gives rise to an implicature that it might/will stop raining later (cf. Krifka 2000). I believe this implicature can be derived using Gricean reasoning. If the speaker believes that the rain will continue to a later time, then they could have expressed that by choosing a different tense, e.g., saying *it will still be raining*. In my analysis, this alternative sentence conveys that the raining continues from past to a time later than now, which is strictly more informative than *it is raining*, since the latter only says that the raining continues to now. A pragmatic speaker thus should have said *it will still be raining* if they could have, in order to embrace the principle of Quantity (i.e., be informative). So, the fact that they have not used it suggests they couldn't have, i.e., it is not in their beliefs that the raining might continue to a later time, making *it is still raining* the most informative utterance they can choose.

In sum, with the added operator CONT, we can derive the temporal continuation meaning through an additive comparison. CONT has a dual function. On the one hand, it provides the gradability and measurement relation required by a comparison: CONT intervenes between the scope-taking tense and associates the time it denotes with all the no-stronger alternative times regarding the scope predicate (i.e., the aspectual predication); these are the *degrees* that the comparison is based on. On the other hand, CONT also turns the additive comparison into a presupposition that follows the tense predication it intervenes. As we have discussed in detail, this presupposed additive comparison eventually reduces to a presupposed temporal continuation from a past time.

### 3.3.2 Deriving variable scales

For any scope-taker $Q$ in a sentence binding a certain variable $x$, the semantics of CONT allows it to intervene between $Q$ and its scope $f$ to introduce the no-stronger alternatives of $x$ regarding $f$. When this operator is not tense, we automatically derive the variety of different scales associated with different flavors of the marginal reading.

The marginal reading of *Anthea is still tall* is derived by having CONT intervene between the subject *Anthea* and the predication of her being tall. The meaning we derive comes out as (145) (see the derivation in Figure 3.3). Let me elaborate on how this is unpacked and reduced to a presupposed scale on heights in (145). Sitting above the predicate of being tall (i.e., reaching the contextually determined standard of being tall, cf. Cresswell 1976, Stechow 1984), the measurement relation that CONT introduces is a relation that projects an individual $x$ who is tall to their no-stronger alternatives, i.e., the set of people whose being tall is entailed by $x$'s being tall. This can only be the people who are at least as tall as $x$, including $x$ itself. So the presupposed additive comparison requires that both Anthea and the alternative individual $y$ are tall entails more people are tall than $y$ is tall alone, which could only be true if $y$ is taller than Anthea – so that including Anthea into the tall people lowers the standard of tallness. Note that both Anthea and $y$ are tall also gives rise to a continuative inference, namely that all the individuals whose heights are between them are also tall, although this time it is redundant because it is already implied by the meaning of being tall.

(145) $\mathsf{POS}(\mathsf{tall})(\mathsf{anthea}) \wedge \underline{\mathsf{ADD}_y(\mathsf{er}_{n',y}(\lambda n \lambda x.\mathsf{POS}(\mathsf{tall})x \wedge n \leq_{\mathsf{POS(tall)}} x))(\mathsf{anthea})} \rightsquigarrow$

$\exists d : \mathsf{standard}\ d \wedge \mathsf{tall}(d, \mathsf{anthea}) \wedge$

$\underline{\mathsf{max}\left\{n \mid \mathsf{POS}(\mathsf{tall})(\mathsf{a} \oplus y) \wedge n \leq_{\mathsf{POS(tall)}} (\mathsf{a} \oplus y)\right\} >}$

$\underline{\mathsf{max}\left\{n \mid \mathsf{POS}(\mathsf{tall})y \wedge n \leq_{\mathsf{POS(tall)}} y\right\}}$

$= \exists d : \mathsf{standard}\ d \wedge \mathsf{tall}(d, \mathsf{anthea}) \wedge$

$\underline{\exists d : \mathsf{standard}\ d \wedge \mathsf{tall}(d, \mathsf{anthea} \oplus y) \wedge y\ \textsf{is taller than anthea}}$

As before, the part of the presupposition that is already asserted in the preceding assertion, i.e., Anthea is tall, doesn't get to project, so the sentence as a whole merely presupposes that someone else is taller than Anthea. In addition, we can derive a pragmatic implicature: if the speaker believes that a certain $x$ who is shorter than Anthea is also tall; by the principle of being informative they should have said *$x$ is still tall*, since that proposition would be strictly stronger than *Anthea is tall*; because the speaker didn't use this alternative sentence, the implicature that anyone shorter than Anthea might not be called tall arises.

(146) $[\![$ Anthea is tall $]\!] \rightsquigarrow$

a. Assertion: Anthea is tall.

b. Presupposition: An alternative individual $y$ is tall and taller than Anthea.

c. implicature: People shorter than Anthea are not tall (i.e. Anthea is only marginally tall).

We derive the marginal reading with a spatial scale when CONT intervenes be-

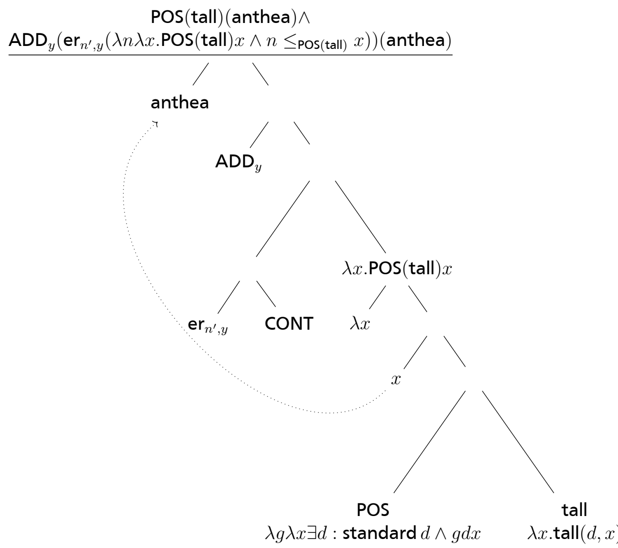



Figure 3.3: Deriving the marginal reading of *Anthea is still tall*

tween a spatial phrase and its would-be scope. For *Durham is still in England*, this phrase is the subject *Durham*, and the meaning we derive will be (147). This time, the measurement relation associates a location $x$ that is in England to all its no-stronger alternatives, i.e., those locations whose being in England is entailed by $x$'s being in England. Such entailment relations seem to be only possible when there is a pre-determined path from the clear-cut cases to the borderline cases, or a path that goes from somewhere in England towards outside, so that one location being England entails all the locations that precede it are also in England. With this pre-determined path, the presupposed comparison that both Durham and the alternative place $y$ are in England entails more places are in England than $y$ is in England alone can only be true if $y$ precedes Durham on the given spatial path. We thus derive the assertion and presupposition in (148), and the implicature arises through pragmatic reasoning again: if there is a place $x$ that is further from $y$ than Durham on the path and $y$ is also in England, the speaker should have said $x$ *is still in England* since it is strictly stronger than *Durham is still in England*, so the fact that that isn't said gives rise to the implicature that there isn't such a place.

(147) $(\textsf{in-england})(\textsf{durham}) \wedge \underline{\textsf{ADD}_y(\textsf{er}_{n',y}(\lambda n \lambda x.\textsf{in-england}\, x \wedge n \leq_{\textsf{in-england}} x))(\textsf{durham})}$

$\rightsquigarrow \textsf{in-england}(\textsf{durham}) \wedge$

$\underline{\max\{n \mid \textsf{in-england}(\textsf{durham} \oplus y) \wedge n \leq_{\textsf{in-england}} (\textsf{durham} \oplus y)\} >}$

$\underline{\max\{n \mid \textsf{in-england}\, y \wedge n \leq_{\textsf{in-england}} y\}}$

$= \textsf{in-england}(\textsf{durham}) \wedge$

$\underline{\textsf{in-england}(\textsf{durham} \oplus y) \wedge y \text{ precedes durham on the spatial path}}$

(148) ⟦ Durham is still in England ⟧ $\rightsquigarrow$

a. Assertion: Durham is in England.

b. Presupposition: An alternative location $y$ is in England and precedes Durham on the pre-determined spatial path that goes from England to not-England.

c. Implicature: Places that are further away than Durham on the path are not in England (i.e. Durham is only marginally in England).

Since the scales associated with a continuative reading are structurally determined by the scope position of CONT, it is not surprising that the same sentence can give rise to more than one continuative reading simply by placing CONT under different licensors. We thus can account for the variability in (136) - (137). The reading in (136) arises when *Peter* takes scope and CONT intervenes between *Peter* and its scope (149): this generates the presupposed additive comparison in (149a), requiring that I can explain exercise two to Peter and an alternative person $y$ entails more people who I can explain it to than that I can explain exercise two to $y$ alone, which can only be true if there is a scale on how easy it is for me to explain exercise two to them and $y$ ranks higher on that scale (i.e., explaining it to $y$ is easier). On the other hand, when *two* takes scope and CONT intervenes between *two* and its scope, the additive comparison is one comparing the number of exercises (150a): that I can explain exercise three and an alternative, exercise $y$, to Peter entails more exercises I can explain to him than I can explain that alternative exercise to him (150). This presupposes a scale ranking exercises on how easily I can explain them to Peter, and it's only true if exercise two is harder to explain.

(149) $[\text{PETER}\,[\,\mathsf{ADD}_y\,[\,[\,\mathsf{er}_{n',y}\,\mathsf{CONT}\,]\lambda x\,[\text{I can explain ex. two to } x\,]\,]\,]\,]$

a. presupposed additive comparison:

$\mathsf{max}\,\{n \mid \mathsf{I\ can\ explain\ ex.\ 2\ to\ peter} \oplus y \wedge n \leq_{\mathsf{I\ can\ explain\ ex.\ w\ to}} (\mathsf{peter} \oplus y)\}$

$> \mathsf{max}\,\{n \mid \mathsf{I\ can\ explain\ ex.\ 2\ to}\ y \wedge n \leq_{\mathsf{I\ can\ explain\ ex.\ 2\ to}} y\}$

b. 
- Assertion: I can explain ex. 2 to Peter.
- Presupposition: I can also explain ex. 2 to an alternative individual $y$, and it is easier to do so than to Peter.
- Implicature: for people who are ranked even lower on the scale (i.e. harder to teach than Peter), I may not be able to explain ex. 2 to them.

(150) $[\text{TWO}\,[\,\mathsf{ADD}_y\,[\,[\,\mathsf{er}_{n',y}\,\mathsf{CONT}\,]\lambda x\,[\text{I can explain ex.} x \text{ to Peter}\,]\,]\,]\,]$

a. presupposed additive comparison:

$\mathsf{max}\,\{n \mid \mathsf{I\ can\ explain\ ex.\ 2} \oplus y\ \mathsf{to\ peter} \wedge n \leq_{\lambda x.\mathsf{I\ can\ explain\ ex.}\ x\ \mathsf{to\ peter}} (\mathsf{2} \oplus y)\}$

$> \mathsf{max}\,\{n \mid \mathsf{I\ can\ explain\ ex.}\ y\ \mathsf{to\ peter} \wedge n \leq_{\lambda x.\mathsf{I\ can\ explain\ ex.}\ x\ \mathsf{to\ peter}} y\}$

b. 
- Assertion: I can explain ex. 2 to Peter.
- Presupposition: I can also explain ex. 2 to an alternative individual $y$, and it is easier to do so than to Peter.
- Implicature: for people who are ranked even lower on the scale (i.e. harder to teach than Peter), I may not be able to explain ex. 2 to them.

We can also explain the role that focus plays in disambiguating these two readings, under the assumption that focused constituents take scope (Von Stechow 1991, Krifka 2006, Charlow 2014, a.o.). When *Peter* bears focus, it triggers *Peter* to take scope, giving us the configuration in (149); when *two* bears focus, it becomes the constituent that scopes out, giving us the configuration in (150).

### 3.3.3 Explaining the typological pattern

Following Thomas (2018), the cross-linguistic ambiguities can be accounted for using a decompositional analysis of CAC operators couched in Distributed Morphology.

Distributed Morphology (DM) is a theoretical framework that emerged in the early 1990s. The name is introduced in Halle and Marantz (1993), with important precursors including Halle (1990), Bonet (1991), Noyer (1992), and Pesetsky (1996). At a broad level, DM represents a set of hypotheses about the interaction among components of grammar. The center of the architecture is the synthesis of the following two hypotheses, both of which are not uncommon in the literature:

(151) **Syntax all the way down:**

The primary mode of meaningful composition, both above and below the word level, is the syntax. Syntax operates on sub-word units, and thus (some) word-formation is syntactic.

(152) **Realization:**

The pieces manipulated by the syntax (*functional morphemes*) are abstract, lacking phonological content. The pairing of phonological features with the terminals of the syntax (*vocabulary insertion* or *exponence*) happens post-syntactically, in the mapping from syntax to phonological form (PF).

Bobaljik (2017): (2)

In Distributed Morphology, the terminals of syntactic structures are morphemes, i.e. sets of features without phonological content; the phonological realization of a morpheme is governed by the subset principle:

> The phonological component of a Vocabulary Item is inserted into a morpheme in the terminal string if the item matches all or a subset of the gram-

> matical features specified in the terminal morpheme. (...) Where several Vocabulary Items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen. [81]

With the subset principle, DM provides a useful toolkit for explaining the possible one-to-many correspondence between the syntactic output representation and the phonological representation. For example, for a morpheme $\{x, y\}$ that consists of two features $x, y$, its phonological realization in a language $\alpha$ is determined by the phonological forms in the lexical inventory of $\alpha$ that match subsets of these features. If $\alpha$ has a form $A$ that matches $\{x\}$ and nothing else, then $A$ will be inserted as the spell-out of either $\{x\}$ or $\{x, y\}$. If there is another form, $B$, in $\alpha$ that matches the feature bundle $\{x, y\}$, then $B$ will be the only possible phonological realization of $\{x, y\}$, since it matches a greater subset of $\{x, y\}$ than $A$. I propose (again following the basic idea proposed in Thomas 2018) this kind of one-to-many correspondence is exactly what we need for to account for the cross-linguistic variation in terms of CAC ambiguities.

A morpheme is a set of features bundled together at one terminal node on the structure, yet our comparative marker, ADD, and CONT are spread out, located at different terminal nodes. Therefore, to apply the subset principle and analyze CAC operators as spell-outs of bundles of features, some structural re-organization is required. Let's assume this is achieved by Merger and Fusion (Halle and Marantz 1993). Merger joins a head with the head of its complement XP. I assume Merger can result in upward movement of a head; consequently, Merger can act as a form of a head movement at PF (Matushansky 2006):

(153) Merger:

a. $[_{X'}[_X F_1][_{YP}...[_{Y'}[_Y F_2]...]]] \rightarrow [_{X'}[_X F_1\ F_2][_{YP}...[_{Y'}[_Y]...]]]$

b. $[_{X'}[_X][_{YP}...[_{Y'}[_Y F_2]...]]] \rightarrow [_{X'}[_X F_1][_{YP}...[_{Y'}[_Y F_1\ F_2]...]]]$

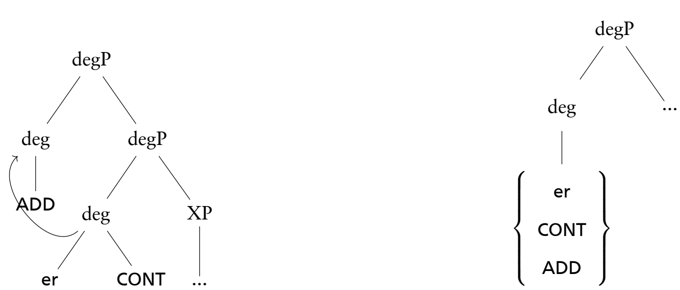

(a) Before (b) After

Figure 3.4: Merger and fusion in additivity

After Merger has applied, adjacent heads can be bundled together by the operation of *Fusion*, which reconfigures a complex head formed of two morphemes into a simpler head with a complex morpheme:

(154) Fusion: $[_X F_1\ F_2] \rightarrow [_X\{F_1, F_2\}]$

In the derivation of an additive comparison, the degree head er undergoes upward head movement to be fused with the head filled by ADD, which results in complex morpheme {er, ADD} (Figure 3.4); in the derivation of a continuative meaning, the complex deg head er-CONT also moves up to be fused with upper head ADD, resulting in a feature bundle {er,CONT, ADD} (Figure 3.5). In a given language, the comparative *more* is the spell-out of the morpheme {er}, the additive *more* is the spell-out of the morpheme {er, ADD}, and the continuative operator is the spell-out of the morpheme {er,CONT, ADD}.




(a) Before (b) After

Figure 3.5: Merger and fusion in continuation

Now we can apply the subset principle to derive the typological distribution of CAC operators. The recurrent ambiguities across different languages and their various patterns can be explained by (i) the three-way logical connection between these three meanings, and (ii) the different lexical inventories in languages as to items matching CAC meanings.

Languages that allow for ambiguity between comparison and additivity but do not extend it to continuation, e.g. English, would be languages that have a lexical item matching the feature {er} (e.g., *more*), and another lexical item matching {er, CONT, ADD} (e.g., *still*), but not a specific one for {er, ADD}. Therefore, when spelling out {er, ADD}, we can only use the phonological form matching the greatest number of subsets, i.e. the one matching {er}; hence the ambiguity between the comparative and additive *more*. For the spell-out of the continuation, because a more specific lexical item matching the entire set is available, the less specific item can't be inserted, therefore the ambiguity with continuation is not possible.

Languages that allow for ambiguity between additivity and continuation to the exclusion of comparison, such as German, would be languages that have a lexical item matching the feature {er} (e.g., *mehr*), and another lexical item matching {er, ADD} (e.g., *noch*), but not one for {er, CONT, ADD}. In these languages, the phonological realization of the additive *more* (i.e., {er, ADD}) can't be the same as the additive *more* (i.e., {er}), because we have a more specific lexical item matching features of the former set. On the other hand, because there is no more specific lexical items matching the morpheme of continuation (i.e. {er, CONT, ADD}), its phonological realization will be the one matching {er, ADD} instead – this derives the ambiguity between the additive *more* and continuation.

Languages that allow for a three-way ambiguity between comparison, additivity and continuation are languages where the most specific lexical item matching subsets of {er, CONT, ADD} is one matching {er} (e.g., Romanian *mai*). Because of the absence of more specific items, both additive *more* and the continuative operator will be spelt-out as the same as the comparative *more*. Reversely, languages where no ambiguities are detected, such as Vietnamese, are languages that have a lexical item $a$ matching {er}, a lexical item $b$ matching {er, ADD}, and yet another one $c$ matching {er, CONT, ADD}. According to the subset principle, the existence of $b$ blocks the insertion of $a$ as the phonological realization of the additive *more*, and the existence of $c$ blocks the insertion of $a$ or $b$ as the phonological realization of continuation. Consequently, no ambiguity arises. These patterns are summarized in Figure 3.6.

| | |
|---|---|
| Comparison/Additivity \| Continuation | English: {er} $\leftrightarrow$ er, {er, CONT, ADD} $\leftrightarrow$ still |
| Comparison \| Additivity/Continuation | German: {er} $\leftrightarrow$ mehr, {er, ADD} $\leftrightarrow$ noch |
| Comparison /Additivity/Continuation | Romanian: {er} $\leftrightarrow$ mai |
| Comparison \| Additivity \| Continuation | Vietnamese: {er} $\leftrightarrow$ hon, {er, ADD} $\leftrightarrow$ nūa, {er, CONT, ADD} $\leftrightarrow$ *van* |

Figure 3.6: Typology of CAC ambiguities

We can also explain the implicational universal in (132). Continuation requires the presence of all three features. If a language has an item $\alpha$ that is homophonous between comparison and continuation, it must be that $\alpha$ matches {er}, and that $\alpha$ is the most specific lexical item matching subsets of $\{\mathsf{er}, \mathsf{ADD}, \mathsf{CONT}\}$, i.e. there is not other lexical item $\beta$ that matches $\{\mathsf{er}, \mathsf{ADD}\}$ or $\{\mathsf{er}, \mathsf{ADD}, \mathsf{CONT}\}$. Therefore $\alpha$ must also be inserted when the feature bundle is {er, ADD}, because it will necessarily be the most specific lexical item matching this set of features. It is thus guaranteed that $\alpha$ can also be used to express additivity.

Note that Figure 3.6 does not exhaust the possibilities provided by the current analysis. For example, it possible that in certain languages, the Merger and Fusion between two degree heads don't apply to begin with. In those languages, we may expect that the two heads are realized as two distinct lexical items that can co-occur. Chinese is a possible representation of languages of this kind; in Chinese, the comparative can have an additive interpretation *if only* there is an additive marker in the same sentence. This is exemplified in (155): the comparatives in (155) are *differential verbal comparatives* (DVC, cf. Li 2009, Luo and Xie 2018), a construction where the comparative word *duo* attaches to the verb. A typical complete DVC is shown in (155b): the comparison standard phrase is introduced by the morpheme *bi*, and the sentence expresses a comparison between the set of things Mary ordered and the set of things John ordered. In (155b), due to the presence of the overt standard phrase *bi ta* ("than her"), the sentence can only be understood comparatively, i.e. that John ordered eight dishes in total. On the other hand, in the little discourse of (155a), the topic sentence makes it clear that we only ordered eight dishes in total, so the following incomplete DVC must be understood additively. Importantly, the additive reading here is strongly associated with the overt additive particles as *zai* ("again") – if this particle is removed, the native speakers report no additive reading, i.e. the comparative would require Mary to order eight dishes.

(155) *Mandarin Chinese*[2]

a. Women yigong dian le ba-ge cai. Mali dian le wu-ge
We together order ASP eight-CL dishes. Mary order ASP five-CL
hun-cai. Ranhou Yuehan you duo dian le san-ge
meat-dish. Then John again *duo* order ASP three-CL
su-cai.
vegetable-dish

"We ordered eight dishes in total. Mary ordered five meat dishes, then John ordered three vegetable dishes."

b. Mali dian le wu-ge hun-cai. Yuehan bi ta duo dian le
Mary order ASP five-CL meat-dish John *bi* 3SG *duo* order ASP
san-ge su-cai.
three-CL vegetable-dish

"Mary ordered five meat dishes. John bought three more stuff than she did, which are three vegetable dishes."

It's worth mentioning here that our current formulation of the proposal is only consistent with one particular view on the relationship of Spell-out to LF/Semantics. Because er-CONT in the current analysis originates in a position created by another

[2] Some notes on the glossing notations I use: I use CL for classifiers, ASP for aspect markers, NEG for negations, 3SG. for third person singular. The comparative item *duo* is not translated in the glosses.

operator's scope-taking, thus the scope-taking of the licensing operator – an operation that does not affect phonology – must precede the insertion of er o er-CONT – an operation that does affect the phonological realizations. This version of the analysis thus argues against a view where there is "covert" syntax mapping Spell-Out to LF; instead it is consistent with a view a single-component grammar (Fox and Nissenbaum, Fox 2002) or a grammar based-on multiple Transfer (Chomsky 2001), where overt and covert movement are interleaved and Spell-Out takes place after covert movement (Bobaljik 2002). Both views are consistent with the architecture of the overall DM architecture, this should not be seen as a problem of the current analysis. However, I hasten to add that when we re-cast the analysis in a specialized framework, in chapter 5, we'll no longer be compelled to choose one of these views.

## 3.4 Comparing theories on CAC operators

There is a considerable amount of work on each one of the CAC meanings. Here, I will not be able to do justice to the entire literature behind any of them; rather, this section will only attempt to situate the current analysis in the background of some most relevant and comparable studies: the studies on the additive use of *more*, recent developments in continuative operators, and the previous account that also addresses CAC ambiguities.

### 3.4.1 Event-relative measurement

So far as I am aware, the additive use of *more* is first discovered in Greenberg (2010). The early studies in this literature typically attempt to derive the additivity by appealing to events and event summation.

In both Greenberg (2010) and Thomas (2010), the additive *more* is an additive operator inside a measurement phrase that serves as a *derived measure function* of events (Krifka 1989, Nakanishi 2007). A derived measure function of events works by creating a homomorphism between the event domain and the domain of one of the event dimensions. In the additive reading of *John bought three more apples*, *more* is attached to the theme role, so a homomorphism $h(e)$ is created between the event and the theme-individuals. Greenberg gives the additive *more* a lexical entry that thoroughly ensures there is some other event that can be summed with the current event, and then $h(e)$ measures the summed event (156). The additive reading of *John bought three more apples* comes out as asserting the summed bigger event measures three-apples-more than the current event, in the range of the event-theme-apple homomorphism. Thomas (2011) has the same basic idea, i.e., additive *more* as an additive measurement on an event-relativized measure function, although executed somewhat differently.

(156) $[\![\text{more}]\!]$[3] $:= \lambda d \lambda Q \lambda P \lambda e. \exists x : [Qx \wedge P(x,e) \wedge \mu(h(e)) = d] \wedge$

$$\underline{\exists e', P', d', y : [Qy \wedge P'(y,e') \wedge \mu(h(e')) = d']} \wedge$$
$$\exists e'' \exists P'' \exists z : [Qz \wedge P''(z,e'') \wedge z = x + y \wedge \mu(h(e'')) = d + d']$$

An obvious issue of this approach is that the additive *more* is treated as a homophonous morpheme to the comparative *more*, therefore it doesn't have much to say about the robustness of this comparison-additivity ambiguity across different languages.

An attempt to unify the additive, event-measure *more* and the ordinary comparative *more* is made in Feldscher (2017). Feldscher adopts the meaning of *more* in (157a) and proposes a summation operation (157b), which maps this degree-addition meaning into a comparison between the summed-up event to the antecedent event (157c)[4]. For *John ran three miles more*, this event comparison relation takes *three miles* as its degree argument, yielding a reading that says the summation of the cur-

[3]I omitted the temporal constraint Greenberg has to make the denotation less cluttered. I also modified the presupposition part: in Greenberg's original proposal, the third line is also presupposed, this is wrong: the negation of the additive reading no longer assumes that there is a bigger event (Thomas). But this doesn't seem to be a deep feature of her theory.

[4]v is the type of events.

rent running event and an antecedent event measures three miles more than that antecedent event.

(157) a. $[\![\text{more}]\!] := \lambda d\lambda d'\lambda\alpha.\mu(\alpha) \geq d + d'$ $\quad\mathsf{d \to d \to a \to t}$

b. $\mathsf{sum}_1 := \lambda f\lambda d\lambda e.\mu(e) = d \wedge f(\mu(e))(d)(e \oplus e_1)$

$(\mathsf{d \to d \to vt}) \to \mathsf{d \to v \to t}$

c. $\mathsf{sum}_1([\![\text{more}]\!]) := \lambda d\lambda e.\mu(e) = d \wedge \mu(e \oplus e_1) \geq d + \mu(e_1)$ $\quad\mathsf{d \to v \to t}$

This is an improvement in uniformity, but it is still unclear how this meaning can be related to continuative meanings in sentences like *it is still raining*. Thus, the cross-linguistic ambiguities with continuation are still left unaddressed.

### 3.4.2 Source of the scale

There is a long list of works on continuative operators like *noch/still* that do not address their morphological connection with comparison. Among them, the analysis in a recent representative, Beck (2020), is most similar – and thus comparable – to my analysis. Therefore I will focus on the comparison to Beck's theory; for a more comprehensive comparison between this approach and the works on continuative particles it comes after (Löbner 1989, Michaelis 1993, Mittwoch 1993, Krifka 2000, Ippolito 2007, Umbach 2009, Umbach 2009), I refer interested readers to Beck's original paper.

Beck proposes the following semantics for a typical continuative particle:

(158) $[\![\text{noch/still}_{S,x^*}]\!] := \lambda x\lambda P.\underline{x \prec_S x \wedge P(x^*)}.Px$ $\quad\mathsf{a \to (a \to t) \to t}$

In words, this says *noch/still* combines with an argument $x$, a predicate $P$, and is anaphoric to an alternative of $x$, $x^*$; it asserts that the predicate $P$ is true of the argument $x$ while adding the presupposition that $P$ is also true of $x^*$, which immediately precedes $x$ on a contextually-determined scale $S$. For the sentence *it is raining*, we will let *still* pick out the temporal scale and generates the interpretation in (160) using the

LF in (159), where *still* takes the scope-taking present tense as its second argument and the scope of the tense operator as its third argument. This meaning translates into the presupposition and assertion in (160a) and (160b). Additionally, given that there are alternative later times that the speaker could have claimed to be raining but did not, it generates the scalar implicature in (161).

(159) $[\,[\,\textsf{still}_{t^*}\ \textsf{pres}\,]\lambda t[\,t[\textsf{impf rain}\,]\,]\,]$

(160) $\underline{t^* \prec_S t \wedge \textsf{impf}(\textsf{rain})(t^*)}.\textsf{impf}(\textsf{rain})(t)$

a. Presupposition: It was rainning in the time $t^*$, a time that immediately precedes the present time.

b. Assertion: It is rainning at the current time $t$.

(161) Implicature: It may stop raining after the present time.

The meaning we have derived for *it is still raining* is entirely equivalent to Beck's results in (160) - (161), and so is the meaning of the marginal readings in *Anthea is still tall* or *Durham is still in England*. In addition, Beck also shows how her theory explains a use of *noch* that she analyzes as modifying a subconstituent. I will show that my analysis generates an equivalent reading for this use as well, and so that the empirical coverage is truly no less than Beck's theory.

This use is exemplified in (162), in which *noch* is adjacent to a temporal adverbial prepositional phrase (notably, the English translation with *still* sounds structurally awkward):

(162) Lydia ist noch am Vormittag abgereist
Lydia is still in the morning left
Lit. "Lydia left still in-the morning. " Beck (2020): ex. (53a)

Beck shows that the targeted reading can be generated using the LF in Figure 3.7a: *noch* modifies the trace position of the past tense inside an adjunct phrase. The result at the top node can be paraphrased in the plain English in (163a) - (163b), which correctly predicts that this sentence generates no presupposition regarding Lydia's leaving. And again, the pragmatic calculation on why the speaker didn't choose to assert about a time later than $\mathsf{past}$ triggers the possible implicature in (164).

(163) a. Presupposition: The prior time $t^*$ is a time in the morning, and it immediately precedes $\mathsf{past}$.

b. Assertion: $\mathsf{past}$ is a time in the morning, and it is a time when Lydia left.

(164) Implicature: Times after $\mathsf{past}$ are not in the morning.

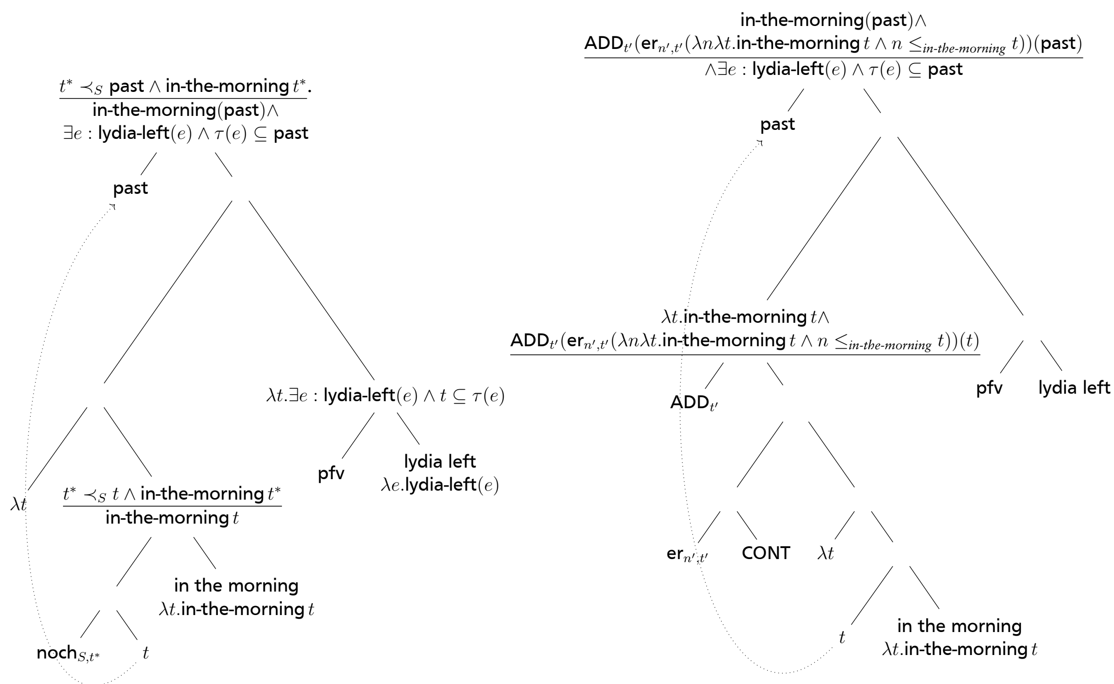
The structural analysis of this sentence in my analysis is only slightly different, as shown in Figure 3.7b: the past tense still originates from an adjunct phrase, adjacent to *in the morning*; after it scopes out, $\mathsf{er\text{-}CON}$ takes scope above its abstraction, and the additive operator $\mathsf{ADD}$ is inserted above. In the meaning we get in the end, we can see that the asserted part is exactly the same as in Beck's analysis (163b). The presupposition part, repeated in (165a), is essentially equivalent to the comparison in (165a) (ignoring the anaphoric test of $\mathsf{er}_{n',d'}$), which is true as long as both $\mathsf{past}$ and $t'$ are in the morning, and $t'$ precedes $\mathsf{past}$. This has one more component than (163a): it contains that $\mathsf{past}$ is a time in the morning in the presupposition as well. However, as we have discussed above, this part of the presupposition won't be projected to the matrix level, because it is exactly the asserted information to which the presupposition is conjoined. Therefore, the presupposition we eventually get for the whole sentence is exactly as in (163a). Finally, with these same entailed meanings, we will generate the same scalar implicature that is in (164).

(165) $\mathsf{ADD}_{t'}(\mathsf{er}_{n',t'}(\lambda n \lambda t.\mathsf{in\text{-}the\text{-}morning}\, t \wedge n \leq_{\mathsf{in\text{-}the\text{-}morning}} t))(\mathsf{past}) \rightsquigarrow$

a. $\mathsf{max}\,\{n \mid \mathsf{in\text{-}the\text{-}morning}(\mathsf{past} \oplus t') \wedge n \leq_{\mathsf{in\text{-}the\text{-}morning}} (\mathsf{past} \oplus t')\} >$
$\mathsf{max}\,\{n \mid \mathsf{in\text{-}the\text{-}morning}\, t' \wedge n \leq_{\mathsf{in\text{-}the\text{-}morning}} t'\}$

b. $\mathsf{in\text{-}the\text{-}morning}(\mathsf{past} \oplus t') \wedge t' \prec \mathsf{past}$

The key intuition in Beck's theory is that the continuative operator intervenes




(a) Composition in Beck's analysis (b) Composition in my analysis

Figure 3.7: Subconstituent-modifying *noch*

between a property and its argument $x$, and adds a presupposition that expresses the *continuation* of this property, i.e. that it also applies to an alternative argument $x'$ that is ranked lower than a scale, and to all that is between $x$ and $x'$ on the scale. This intuition is fully preserved in my analysis – albeit with a little difference in how the operator takes scope – so it also inherits all the main benefits of Beck's proposal.

What sets us apart is how the presupposition in the targeted meaning is derived. In Beck's theory, it comes from a scale that is entirely contextually determined. In fact, that the scale is encoded as a contextually determined variable has been the standard practice in this literature on continuative particles. In my analysis, this has changed: the presupposition is generated as a presupposed comparison and the scale is directly determined by the comparison. The role of the context is greatly restricted in my analysis, and the scale utilized in continuation is determined by the sentence containing the continuative operator and its scope configurations.

I believe this is a change in the right direction, as we do observe that the scale is never freely supplied by the context. For example, the two sentences *Anthea is still short* and *Anthea is still tall* presuppose two opposite scales even when they are used as the response to the same question in (166). We know that the scales are different because their meanings are different: (166a) presupposes that someone else other than Anthea – maybe one who is not in this group – is shorter and generates an implicature that anyone higher than Anthea is no longer short, whereas (166b) presupposes someone else is taller and generates an implicature that anyone shorter than Anthea is no longer tall. Given that the question is exactly the same, it is unclear how the same minimal context in (166) should supply two different scales for these two sentences.

(166) – Is everyone in this group tall?

a. – Anthea is still short (but the rest of them are tall).

b. – Anthea is still tall (but the rest of them are short).

For my analysis, where the scales are structurally determined, the difference in (166a) - (166b) is entirely expected. In *Anthea is still short* (166a), er-CONT can only take scope over a property of being short, thus the presupposed comparison is one between Anthea and someone else, $y$, on their no-stronger alternatives in terms of being short, requiring *Anthea and $y$ are short* entails more people are short than *$y$ is short*, i.e. $y$ is shorter than Anthea. On the other hand, the scope property of er-CONT can only be the property of being tall, and it naturally predicts that the comparison ranks people in opposite directions: that *Anthea and $y$ are tall* is required to entail more people are tall than *$y$ is tall*, i.e. $y$ is taller than Anthea.

### 3.4.3 Scale segments

As I have mentioned before, Thomas (2018) is the only account in the existing literature that addresses the CAC ambiguities across languages. While my analysis has adopted some key insights of Thomas's theory, there are also non-trivial differences between my analysis and his, most crucially on the formal representation of a comparison meaning.

Thomas's (2018) account is implemented using the scale segment semantics proposed in Schwarzschild (2013). A scale segment $\sigma$ is an abstract entity derived from scales, formally a quadruple $\langle u, v, >_\sigma, \mu_\sigma \rangle$ such that $u$ and $v$ are two measurements that are the beginning and the end of the segment, $\mu_\sigma$ is the measurement function of the scale, and $>_\sigma$ is the partial ordering on the scale. The meaning of a comparative is a quantification over scale segments; e.g., *Mary is taller than John* is rendered as (167), which says that there is a scale segments tht starts from John's height and ends with Mary's height, and it is a rising scale segment ($\nearrow \sigma$), i.e., the end of the segment exceeds the start.

(167) $\exists \sigma.\mathsf{START}(\sigma, \mu_\sigma \mathsf{j}) \wedge \nearrow \sigma \wedge \mu_\sigma = \mathsf{HT} \wedge \mathsf{END}(\sigma, \mu_\sigma \mathsf{m})$

The introduction of this abstract entity provides a structured representation of

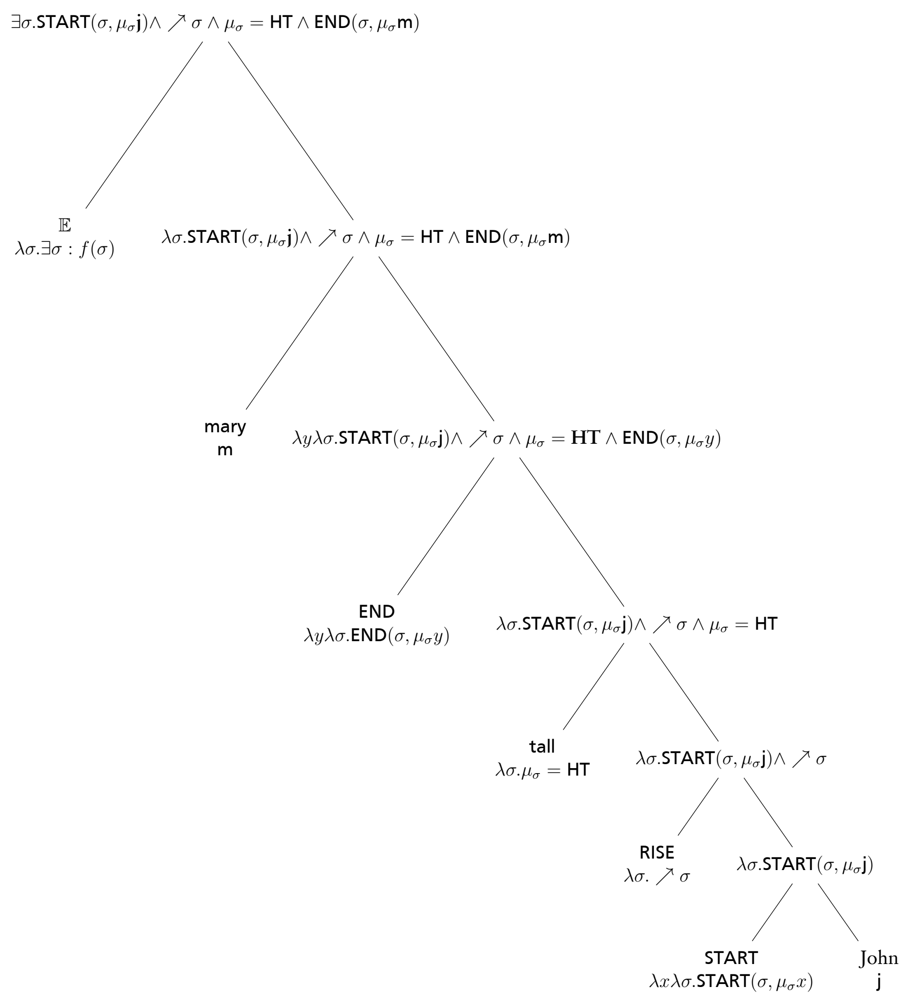



Figure 3.8: Composing *Mary is taller than John* in scale segment semantics

the information related to a comparison, like eventualities do action/state-related sentences. Therefore also like events, scale segments allow the various components of the sentence to be composed together intersectively. This is shown in Figure 3.8 in detail: adjectives denote predicates of scale segments and the standard and the target of the comparison are turned into predicates of scale segments through thematic heads like START and END.

Thomas proposes an additive operator ADD:

(168) ADD[5] := $\lambda\Sigma\lambda\Sigma'\lambda x\lambda\sigma.\Sigma(\sigma)(g_1) \wedge \Sigma'(\sigma)(x \oplus g_1)$

$$(\mathsf{e} \rightarrow \mathsf{l} \rightarrow\ ) \rightarrow (\mathsf{e} \rightarrow \mathsf{l} \rightarrow \mathsf{t}) \rightarrow \mathsf{e} \rightarrow \mathsf{l} \rightarrow \mathsf{t}$$

[5] l is the type for scale segments, i is the type for times.

Its function can be better appreciated with the composition in Figure 3.9. Here ADD takes the two thematic relations of the scale segment, its start and its end, and manually fixes them so that the comparison comes out comparing the measurement of the summation of the would-be target (i.e., apples that John bought) and a discourse antecedent $g_1$ to the measurement of $g_1$. In the end, the additive reading of *John bought three apples* is predicted to be the following: there is a rising scale segment that starts with some contextually salient (plural) individual $g_1$, and ends with the sum of $g1$ and the apples John bought.

The temporal continuative reading of *it is still raining* is derived using another operator CON, defined in (169) (where $\mathsf{INIT}(e, \epsilon)$ means $e$ is not the initial stage of the event $\epsilon$, and $\mu_\sigma = \mathsf{STAGE}$ means the measurement of the scale segment is on the developmental stages of $\epsilon$): it takes a thematic relation and a relation between an event and a time, and returns a presupposed rising scale segment on the event-development[6]. Figure 3.10 shows the complete derivation of *it is still raining*, and the meaning we get says that there is an ongoing raining event $e$, and it's presupposed that there is a rising scale segment on the developmental stage of some event $\epsilon$, such that it starts from the stage of an antecedent event $g_1$ and ends with $e \oplus g_1$.

(169) $\mathsf{CON} := \lambda\Sigma\lambda R\lambda e\lambda t.R(e)(t)\wedge$

$$\underline{\exists\sigma\exists\epsilon\exists t'[R(\epsilon)(t') \wedge \neg\mathsf{INIT}(e,\epsilon) \wedge \mu_\sigma = \mathsf{STAGE}_\epsilon \wedge \Sigma(e)(\sigma)]}$$

$$(\mathsf{e} \to \mathsf{l} \to \mathsf{t}) \to (\mathsf{v} \to \mathsf{i} \to \mathsf{t}) \to \mathsf{v} \to \mathsf{i} \to \mathsf{t}$$

Although the technical details appear to be wildly different, it is worth pointing out that what makes deriving additivity from comparison possible in this approach is an intuition very close to our current proposal: the comparison meaning is captured as a comparison between two correlates (i.e., the arguments of two thematic heads,

[6]Thomas gives the aspect a different meaning than what I take to be the standard practice in Kratzer (1998), so that the imperfective aspect introduces the event-time relation but does not existentially close the event. I'm not clear on the reason behind this choice. It seems to me that the analysis can be simplified if we adopting the Kratzerian aspect meaning and get rid of the time component in the definition of CON.

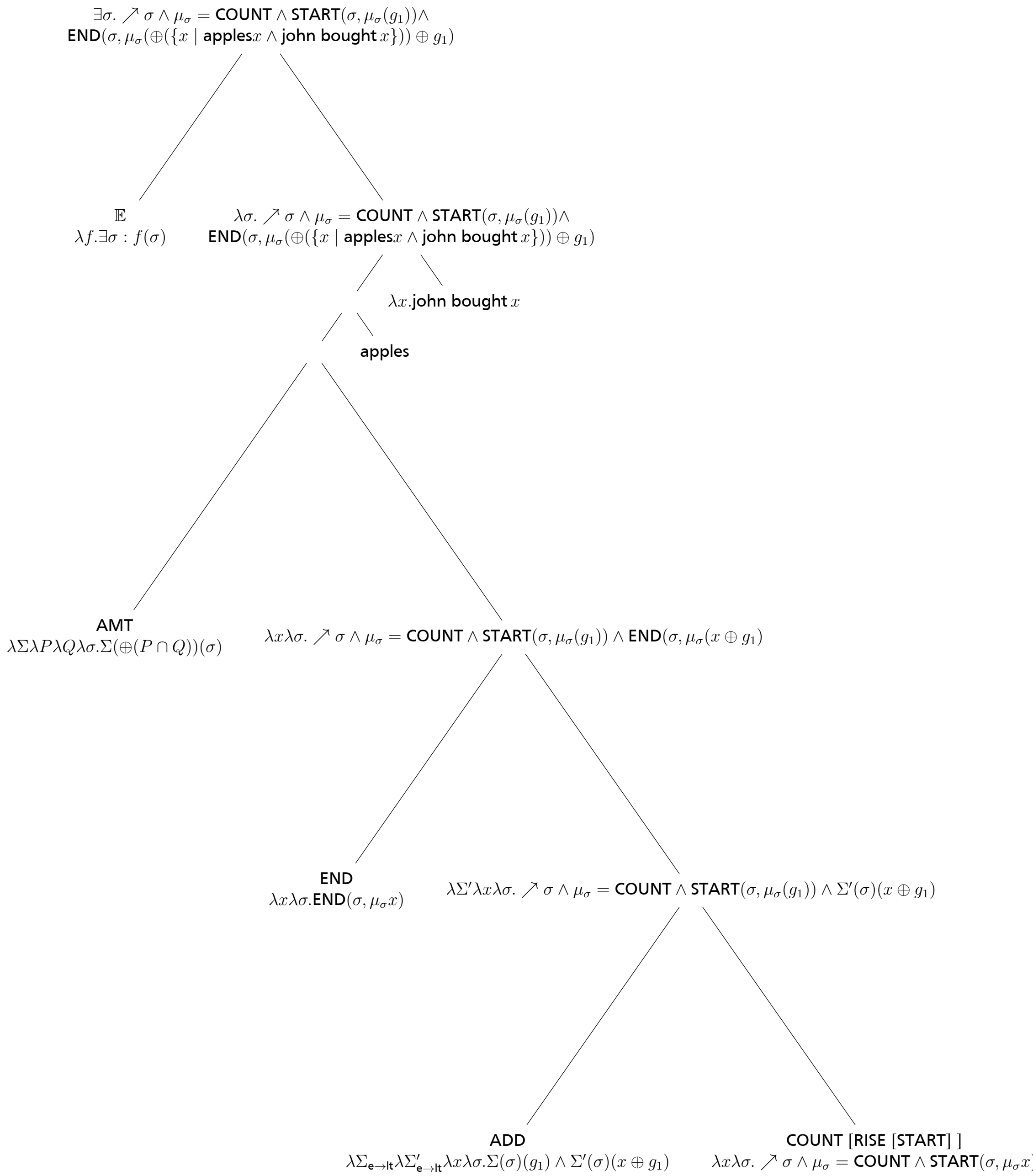



Figure 3.9: Composing the additive reading in scale segment semantics

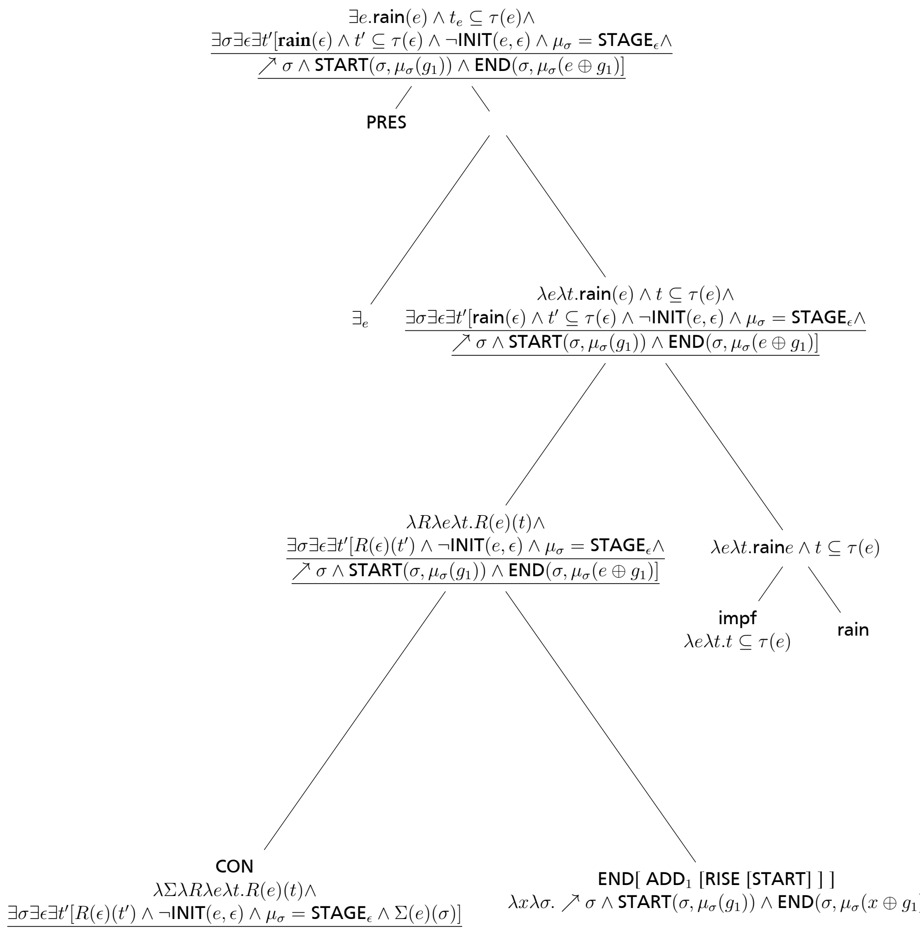



Figure 3.10: Composing temporal continuation in scale segment semantics

START and END) on the given measurement function. Just like in my analysis, the additive operator sums up the two correlates before the comparison is conducted.

We differ in the modeling of the continuative reading, and more specifically the measurement function invoked in the continuative reading. While in Thomas' proposal temporal continuation is derived as a presupposed comparison on event development, in my analysis the presupposed comparison is about times on a structurally derived measurement function, i.e., their no-stronger alternatives in terms of the scope property. It remains unclear how event development can be used to capture the other flavors of continuation apart from the temporal use, or the possible focus disambiguation effect. On the contrary, my scope-based theory naturally predicts this wide range of variations, simply by having the scope configuration of the sentence determine the measurement function for the comparison.

I hasten to add that this lack of flexibility comes from the particular way of defining CON, not the framework of scale segment semantics. Defining a structurally oriented measurement function for a scale segment is possible; for instance, if we give CON the meaning in (170), which defines the measurement function to be the no-stronger alternatives of a scope-taker, it will be able to derive all the continuative readings that my analysis can. But then the resulting theory will be very much similar to my analysis – where the success of getting the correct results depends on having the comparative operators take parasitic scope under its licensor, not the adoption of scale segments.

(170) CON := $\lambda\Sigma\lambda R\lambda x.Rx \wedge \underline{\exists\sigma : \mu_\sigma = \lambda x.\mathsf{max}\{n \mid fx \to fn\} \wedge \Sigma(x)(\sigma)}$

$(\mathsf{a} \to \mathsf{l} \to \mathsf{t}) \to (\mathsf{a} \to \mathsf{t}) \to \mathsf{a} \to \mathsf{t}$

Thomas also noted that scale segments may be helpful in getting the blocking effect of the overt standard. The idea is that in his analysis, in an additive comparative the thematic head START is introduced by ADD; since *than* is the spell-out of START, in order to make the overt *than*-P occur in an additive comparative we will have to re-introduce the role of START a second time in the structure. Thomas argues that this might be a violation of *thematic uniqueness* if we take the analogy between scale segments and events seriously. *Thematic uniqueness* is a constraint against introducing the same thematic role more than once (Carlson 1984, Kratzer 2003, a.o.), yet, it is more of a descriptive rule whose precise nature remains to be determined (but see some discussions in Williams 2015). The predictions of the correlate-based analysis in terms of this blocking effect cannot be evaluated until we have a complete theory for explicit comparatives. I will propose such an extension in the next chapter, with which the blocking effect can also be accounted for.

Finally, we find that the additive *more* is as sensitive to sentential negation as the normal comparative one, a data point similar to what we've seen in chapter 2 and that the scale segment semantics in this account can't explain. For instance, with the negation in (171), the comparative in (171b) is unacceptable, whether it's the normal comparative (i.e. John bought more than three apples) or the additive use (i.e., John bought any apples at all). The infelicity of this failure couldn't be attributed to the inaccessibility of *the three apples*, because (171a) shows it can be referred back using an individual pronoun. In Thomas' scale segment semantics, *John bought more (apples)* is only anaphoric to an antecedent that can be summed up with the apples John bought, therefore it provides no explanation as to why (171b) is infelicitous. On the contrary, in my analysis the additive *more* still carries a definedness condition that the degree antecedent is the measurement of the comparison correlate on the given function; since the negation has negated *three* to be the amount of apples Mary bought, (171b) is predicted to be infelicitous because this presupposition is not met.

(171) Mary didn't buy those three apples$^x$.

a. They$_x$ are too big.

b. # John bought more$_x$.

## 3.5 Chapter wrap-up

I hope to have convinced you in this chapter that the correlate-comparison meaning provides a simple account of the cross-linguistic ambiguities between comparison, additivity, and continuation.

The data pattern is introduced in section 3.2. There are two main data points: (i) morphemes that are ambiguous between the three meanings are frequently attested in a diverse set of languages; (ii) a continuative operator can also give rise to different flavors of continuation, depending on the scale it picks up. The only theory we have for the former is not flexible enough to explain the variability of continuation meanings, while the existing literature focusing on the latter doesn't address CAC ambiguities.

Section 3.3 presents the formal analysis. Starting with a comparative meaning as a comparison between two correlates, I have shown that we can derive additivity using an operator ADD, which sums up the two correlates and re-assign the sum to be the target of comparison. Deriving continuation from additivity takes another operator CONT: CONT intervenes between an argument $x$ and a predicate $f$ and returns a conjunctive meaning: the original predication $f(x)$, followed by a presupposed additive comparison between $x$ and an alternative argument on their no-stronger alternatives on the given predication. This account can be used to generate different scales associated with a continuation, depending on the scope configuration of the sentence. I have also shown that the de-compositional analysis of CAC operators in Thomas (2018) can be preserved in this analysis, explaining the cross-linguistic ambiguities.

Section 3.4 evaluates the advantages of the current analysis, both in addressing CAC ambiguities and its characterization of the three meanings. In comparison to previous theories that focuses on only one of the CAC meanings, the current analysis has an advantage in addressing the cross-linguistic ambiguities. In addition, compositionally encoding comparison into the meaning of continuation is also helpful in explaining how continuative operators choose the appropriate scale. In comparison to the previous account on CAC ambiguities, I have shown that the current analysis is ontologically simpler (it does not assume an additional abstract entity) and has a better empirical coverage.

# CHAPTER 4
# INTRASENTENTIAL ANAPHORA IN COMPARISON

## 4.1 Introduction

We still need to situate the correlate-based re-analysis in the bigger context of comparative semantics. In particular, we have not yet replaced the null hypothesis repeated in (172) with an alternative understanding of the relation between the anaphoric *er* and explicit comparative constructions.

(172) In anaphoric comparatives, the standard argument of $[\![\text{er}]\!]$ is reduced to a covert pro form.

This is what this chapter is set to accomplish. In a nutshell, I propose to replace the standardly assumed function-argument relationship between the comparative marker and the overt standard with intrasentential anaphora. As a consequence, explicit and (discourse) anaphoric comparatives are only different in the ways *er* finds its binder.

The idea is simple: just like the (discourse) anaphoric *taller* in *John is taller* is bound by an antecedent correlate of comparison and its height, *er* in the explicit comparative *John is taller than Mary is* is bound by the explicit correlate, Mary, and her height. However, the technical execution is problematic in the static framework, given that the targeted binders in an explicit comparative don't appear in a position that can bind *er*. I will show these difficulties can be overcome once we re-cast the proposal from chapter 2 in a dynamic framework. The resulting theory is fully compositional, and also capable of handling the variety of different explicit comparative constructions there is. The new relation between the *than*-clause and *er* also explains some classic puzzles in the comparative literature.

I will begin, in section 4.2, with a detailed discussion on why our proposal of *er* from the last chapter does not connect well with the meaning of the comparative construction assigned by the traditional approach and sketch of the gist of the intrasentential anaphora proposal. Section 4.3 introduces the framework of a simple dynamic semantics, which the analysis will be couched in. Section 4.4 sketches the first dynamic analysis of *er*, and I will go through some implications of the resulting theory on the parallelism between the scope of *er* and the elided content in the *than*-clause, in section 4.5. In section 4.6 I show that the theory in this chapter provides a new way to directly interpret *than*-clause internal quantifiers, but it faces challenges when dealing with certain quantifiers like *most*.

I propose that the problem can be solved if we de-compose comparative anaphora into two parts: an introduction of an indefinite standard correlate, followed by an anaphoric resolution of its identity, which is a *postsupposition*. This alternative analysis not only helps us to solve the proportional quantifier problem, but also makes it possible to explain an issue concerning the interaction between explicit comparative constructions and CAC ambiguities that we have discussed in the previous chapter. Section 4.7 presents and this second, postsuppositional analysis, and discusses the consequences of the postsuppositional analysis regarding quantifiers, comparing this theory to the existing literature on *than*-clause internal quantifiers. Section 4.8 discusses why CAC ambiguities are always blocked in an explicit comparative construction, and proposes a solution based on the postsuppositional analysis of *er*. Section 4.9 concludes.

## 4.2 Towards a unified comparative meaning

### 4.2.1 Not the anaphoric form of the phrasal *er*

Despite the apparent resemblance between the anaphoric *er* in my proposal (173) and the phrasal *er* in the direct analysis (174), (173) is unlikely a derived form of (174).

(173) $[\![\, \text{er}_{d',y} \,]\!] := \lambda f \lambda x.\underline{d' = \mathsf{max}\,\{d \mid fyd\}}.\mathsf{max}\,\{d \mid fxd\} > d'$

(174) $[\![\, \text{er} \,]\!] := \lambda y \lambda f \lambda x.\mathsf{max}\,\{d \mid fxd\} > \mathsf{max}\,\{d \mid fyd\}$

For starters, we have no principled way of deriving (173) from (174). As I have argued in the previous chapter, if all that happens in anaphoric comparatives is the standard argument of $[\![\, \text{er} \,]\!]$ is reduced to a covert pro-form, the anaphoric form we can derive from (174) is one anaphoric to a correlate, not (173), which is also anaphoric to a degree antecedent.

An additional worry is that the (174) can't be the *only* lexical meaning of *er*, and there are doubts about whether it is ever an available meaning of English *er*. Whether the lexical entry in (174) is the right analysis for English phrasal comparatives has been debated a lot (Heim 1985, Lechner 2001, 2004, Bhatt and Takahashi 2007). The main competitor is the ellipsis analysis, in which the *than*-P in a so-called phrasal comparative is also underlyingly clausal, only that it undergoes more radical surface reductions; for example, the underlying structure for *John is taller than Mary* would be, roughly, *John is taller than Mary is tall*. Multiple arguments against the direct analysis have been raised and defused, but I believe there is at least a valid one in Bhatt and Takahashi (2007). The argument is based on the binding principle C: a pronoun can't be co-construed with an R-expression (e.g. proper names) it C-commands. Now consider the example sentences (175a), where the target correlate is marked in boldface. The ungrammaticality between (175a) and (175c) can be easily explained in an ellipsis analysis, since in this analysis the target and the standard correlate are always situated in exactly the same structural position (after ellipsis resolution). Thus, if *him* C-commands *Sally* in the matrix comparative clause, in the *than*-P there is a *him* C-commanding *Peter* as well; the co-indexed interpretation between *him* and *Peter* in (175a) is ruled out because of Principle C violation. The ungrammaticality goes away when the pronoun no longer C-commands the target correlate, as in (175c). In contrast, under the direct analysis, there is no correlation between the position of the target and the standard correlate are unrelated, thus it offers no straightforward account of the difference between (175a) and (175c). Bhatt and Takahashi (2007) concludes that the direct analysis can't be at work in English phrasal comparatives.

(175) a. * More people introduced him$_i$ **to Sally** than to Peter$_i$'s sister.

b. More people introduced Peter$_i$ **to Sally** than to his$_i$ sister.

c. ? More people introduced **Sally** to him$_i$ than Peter$_i$'s sister.

d. More people introduced him$_i$ **to Sally** than to himself$_i$.

Bhatt and Takahashi (2007): (20)

Even if we grant that the lexical entry in (46) is available in English, it would necessitate a dichotomy between phrasal/clausal comparatives. The direct analysis is proposed in the general frame of the traditional approach, where *er* takes the denotation of the *than*-P is as its semantic argument. As such, it is tied to a correlate-denoting *than*-P. Yet the *er* in sentences like *the door is taller than it is wide* can't take a correlate argument, since the complement of *than* is unequivocally clausal. So, within the bounds of the traditional approach, whether we adopt the direct analysis or not, the clausal *er*, which takes a degree (set) argument, is independently motivated. If (46) is only the anaphoric form of the phrasal *er*, we could very well imagine that the clausal *er* has its own anaphoric form, anaphoric to a bare degree (set). Then the predictions for anaphoric comparatives are not at all clear. If a charitable interlocutor simply switches to anaphora to a degree (set) in contexts where anaphora to a correlate is infelicitous, we should not be able to observe the constraints demonstrated in the last chapter.

### 4.2.2 Potential solution: intrasentential anaphora

Now I will sketch an idea that will potentially address all of the above concerns: replacing the presumed function-argument relation between the comparative marker and the overt standard with anaphora.

The idea is the comparative marker *never* has an argument slot for the standard; instead, the standard correlate(s) and the standard degree are its implicit arguments (cf. Larson and Wellwood 2015). We thus replace the null hypothesis with (176):

(176) Anaphoric and explicit comparatives use different strategies to resolve *er*'s implicit arguments.

So *er* always has the meaning along the lines of (173). Only that, whereas in anaphoric comparatives the implicit arguments $d', y$ are resolved to discourse antecedents in the prior context, in explicit comparatives they are resolved to semantic objects introduced by the *than*-P: the *explicit correlate* and its maximal measurement degree introduced by a covert degree operator Op (cf. Chomsky 1977). For example, *Mary is taller than John* can have roughly the structure illustrated in (177) (arrows here indicate co-construal, not movement); the correlate $y$ is resolved to *John* and the standard degree $d'$ is resolved to the maximal degree we get from Op's maximization, i.e., John's height.

(177) [ [ John$^x$ [ er$_{y,d'}$ $\lambda d \lambda x$ [ $x$ is $d$-tall ] ] ] [ than [ Op$^{d'}$ $\lambda d'$ Mary [ is $d'$-tall ] ] ] ]

$$\text{Op} := \lambda f. \exists m = \mathsf{max} f$$

Different from the direct analysis, with this we can get correlate comparisons without a phrasal-denoting *than*-P. As we have seen in (177): the *than*-P is a coordinated clause, so there need not be lexical ambiguity between phrasal and clausal comparatives.

There is a technical problem in the implementation: it is not obvious how these objects in the *than*-clause *can* bind *er*'s implicit arguments. In the current technical setting, establishing a binding relation between, say, *er*'s implicit correlate and *Mary* in *John is taller than Mary* would require *er* to be in their scope, which is very difficult to achieve in the current framework. In fact, it would require scoping *Mary* and Op to an exceptionally high position to get *er* in its scope. Roughly:

(178) [ Mary$^y$ $\lambda y$ [ Op$^{d'}$ $\lambda d'$ [ John [ er$_{y,d'}$ $\lambda d \lambda x$ [ $x$ is $d$-tall ] ] [ than [ $y$ is $d'$-tall ] ] ] ] ]

(178) is suspect for two reasons. First, it is generally believed, since Schwarzchild and Wilkinson (2002), that the *than*-P behaves like a scope island otherwise, so the scope-taking in (178) must not obey the relevant locality constraint that for some reason. Second, and more importantly, allowing for this kind of scoping mechanism can lead to weak crossover violations. Since in (179) *every* isn't allowed to take scope only to bind *him* (Postal and Postal 1971), neither should we expect *Mary* and Op to take scope only to bind a variable that is otherwise higher on the structure, as in (178).

(179) # The shark next to him$_x$ attacked every$^x$ diver

I propose to move to dynamic semantics to solve this dilemma. In dynamic semantics, it is possible to *delay* the anaphoric resolution till after the interpretation of the *than*-P, and then the binding between the semantic objects inside the *than*-P and *er*'s implicit arguments can be just standard dynamic binding.

How can we delay the resolution of comparative anaphora? In this chapter I will consider a most straightforward solution: defining an operator that simply lets the *than*-P to be interpreted before the matrix comparative clause.

## 4.3 Dynamic semantics

Before getting to the proposal, I'll use this section to first introduce the formal framework that the dynamic analysis will be couched in. For those who are already familiar with dynamic theories: the framework I'll eventually settle on (for this and

| Type | Name | Variables | Constants |
|---|---|---|---|
| $\mathsf{t}$ | truth values | | 1, 0, # |
| $\mathsf{e}$ | individuals | $x, y, z$ | john (or j) |
| $\mathsf{d}$ | degrees | $d$ | five feet (or 5ft) |
| $\mathcal{V}$ | registers | $u, v$ | |

.

Figure 4.1: Basic types

the next chapter) is essentially Muskens' Compositional Discourse Representation Theory (CDRT).

Dynamic theories of semantic interpretation since Kamp (1981), Heim (1982) take the influence of the context in a strictly local way. Instead of writing it into the sentence-level evaluation as in static semantics, in dynamic semantics the context is accessible to interlocutors at any given time of a discourse.

To formally capture this, we add one more basic type into the semantic interpretation, on top of the three common static types that are going to be useful for us: type $\mathsf{t}$ is for truth values, $\mathsf{e}$ is for individuals, and $\mathsf{d}$ is for degrees. The one addition is the type for *registers* (Figure 4.1). Following the metaphor in Muskens (1996), we can think of registers as chunks of spaces or *stores* that have informational objects inside. As a discourse unfolds, some objects get stored in a certain register so that we can refer back to them at a later point. This is called introducing a *discourse referent* (dref), whereas the denotation of a dref is just a register. Formally, *register* is just another name of variables; I give it type $\mathcal{V}$ to signal this connection. I will sometimes use subscripts to distinguish drefs pointing to different types of things, e.g., $\mathcal{V}_{\mathsf{e}}$ would be a type for a dref pointing to individuals.

Discourse contexts are modeled using sequences of registers, called *information states*. They are formally equivalent to partial assignment functions, i.e. functions from variables to any type of objects, with the derived type $\mathsf{g} ::= \mathcal{V} \to \mathsf{a}$ where $\mathsf{a}$ is a placeholder for any random type[1].

[1] Muskens warns that having info-state-sensitive drefs might lead to inconsistency. See Hardt (1999), Charlow (2017) for some solutions of the technical problems.

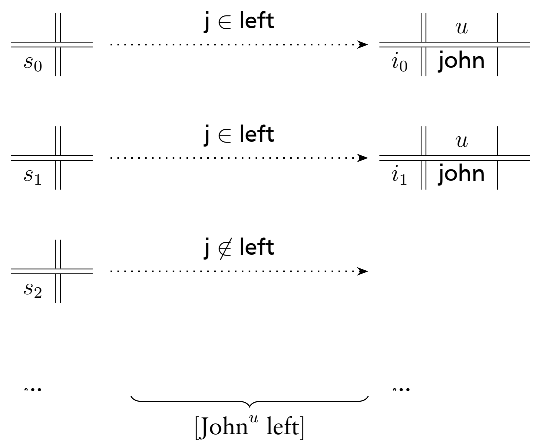



Figure 4.2: Visualized context updates of *John left*

I will use the single squared bracket [ ] as the dynamic correspondence of the (static) interpretation function $[\![\ ]\!]$. The dynamic interpretation of a proposition $p$, $[p]$, is a context change potential (CCP), an instruction of updating the discourse context, which could be introducing information (thus testing possibilities still alive at that point) or introducing referents that could be picked up later on, or both. Formally, a CCP is a relation between info states, type $\mathcal{T} ::= \mathsf{g} \to \mathsf{g} \to \mathsf{t}$. Take the sentence *John left* for example. Its dynamic meaning is a relation associating an input state and its output after the update, i.e. a function from a state to the characteristic set of its output (180), and the output is the same as the input except that it assigns $u$ to $\mathsf{john}$ and John left is guaranteed to be true in that state. The updates are depicted in Figure 4.2: upon uttering this sentence, all the info states store $\mathsf{john}$ at a register $u$ (so that we could later refer back to him); it also tells us that he left, so any state (e.g., $s_2$) where this is not true gets filtered out.

(180) [ John$^u$ left ] := $\lambda s. \left\{ s^{u \to \mathsf{j}} \mid \mathsf{j} \in \mathsf{left} \right\}$ $\qquad \mathcal{T}$

Truth and falsity can be defined in terms of the output set of the update:

(181) A CCP $m$ is true at an info state $s$ iff $\exists i \in s[m]$.

(182) A CCP $m$ is false at an info state $s$ iff $s[m] = \emptyset$.

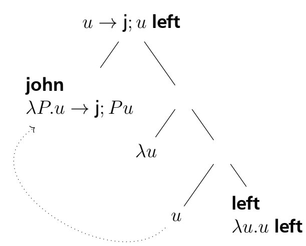



Figure 4.3: Deriving a CCP compositionally

Dynamic conjunction, denoted by the symbol ;, is defined as relation composition (183). By this definition, we sequence two CCPs $p$ and $q$ by first updating with $p$ and then feeding the output point-wise to $q$, and finally taking the union of the results.

(183) $p; q := \lambda s.\, \{i \in qs' \mid s' \in ps\}$ $\qquad \mathcal{T} \to \mathcal{T} \to \mathcal{T}$

Dynamic propositions like (180) can be assembled in a fully compositional manner (Groenendijk and Stokhof 1991, Muskens 1996). Derivatively then, dynamicity is also present in the meaning of sub-clausal constituents. Dynamic predicates like **left** take drefs and return a CCP - a test that filters out certain states (see (184); we are using abbreviations, as the set representation will quickly get too complicated to parse). Dynamic noun phrases introduce drefs. For example, **john**$^u$ in (185) takes a dynamic property $P$ and an input state $s$, updates $s$ by first assigning $u$ to john (introducing a dref), and then sequencing it with the scope update $Pu$. Assembling these meanings with the derivation in Figure 4.3 gives us the meaning on top of the tree. Readers are welcomed to check that the result we've got here is equivalent to (180).

(184) $[\text{left}] := \lambda u.\textbf{left}\ u$, where $\textbf{left}\ u := \lambda s.\, \{s \mid s_u \in \text{left}\}$ $\qquad \mathcal{V} \to \mathcal{T}$

(185) $[\text{john}^u] := \lambda P.u \to \mathsf{j}; Pu$, where $u \to \mathsf{j} := \lambda s.\, \{s^{u \to \mathsf{j}}\}$ $\qquad (\mathcal{V} \to \mathcal{T}) \to \mathcal{T}$

Dynamic existential quantification amounts to extending the info states with non-deterministic assignments of a new variable (186). As a consequence, one characteristic feature of dynamic interpretations is existential quantifiers can bind downstream

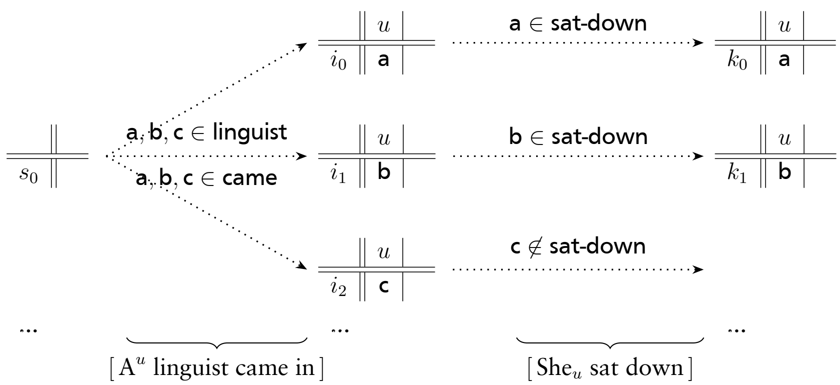



Figure 4.4: Cross-clausal anaphora to an indefinite

across clause boundaries.

(186) $[\exists u] := \lambda s.\,\{s^{u\rightarrow x} \mid x \in D\}$

The motivation and the main application of this feature has been the exceptional binding potential of indefinite noun phrases, witnessed by (187). With (186), the dynamic meaning of the indefinite *a*$^u$ *linguist* in (188) associates a (new) variable $u$ with possibly different linguists. Correspondingly, the meaning of the sentence a$^u$ *linguist came in* is a nondeterminisitic update: given any info state, it outputs a set of states with $u$ assigned to a linguist who came in that state; this is visualized in the first part of Figure 4.4. After this, a subsequent sentence containing a co-indexed pronoun can, of course, refer back to this variable and impose further conditions on it: *She*$_u$ *sat down* further updates the context by filtering out any assignment of $u$ who did not sit down (the second part of Figure 4.4). This way, the existential quantification of the indefinite effectively binds the pronoun *she* in the second sentence.

(187) A linguist$^u$ came in. She$_u$ sat down.

(188) [a$^u$ linguist] := $\lambda P.\exists u; \textbf{linguist}\ u; Pu$ $\qquad \mathcal{V} \rightarrow \mathcal{T} \rightarrow \mathcal{T}$

## 4.4 Firstt attempt

### 4.4.1 Dynamic *er*

The first step is to dynamicize the meaning we have for *er*. This is done in (189):

(189) $[\![\text{er}^{m,n}_{n',u'}]\!] := \lambda f \lambda u.\textbf{max}^m(fmu'); \textbf{max}^n(fnu); n > m; \underline{m = n'}$

$$(\mathcal{V}_{\mathsf{d}} \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}$$

$$\textbf{max}^u := \lambda m \lambda S.\, \{I \in S[\exists u; m] \mid \neg\exists K \in S[\exists u; m] : K_u > I_u\}$$

$$\text{For any CCP } m, \underline{m} := \lambda s. \begin{cases} \{s\} \text{ iff } m \text{ is true at } s \\ \text{undefined otherwise} \end{cases}$$

The operator **max** maximizes the variable it introduces relative to the CCP in its scope. $\textbf{max}^u[m]$ updates the context by first introducing a dref $u$ and passing it on to the update $m$, and then collects the output, filtering out the states where the $u$-value is not maximal, i.e. less than the $u$-value in some other state that also survives the $m$-update. The two **max**s in 189 are both degree maximizations, the first one maximizes the $m$-value that makes $fmu'$ is true, and the second one maximizes the $n$-value that makes $fnu$ true.

The underline still indicates a definedness condition. In dynamic semantics, a dynamic test $m$ is a definedness condition just in case it returns *undefinedness*, as opposed to falsity, when it fails to update any input state $s$. Assuming undefinedness at any state results in undefinedness of the entire update, this means $m$ must be true at any input state, or else the update is undefined. In other words, if $m$ is a definedness condition, its information must have already been entailed by the input context.

According to (189), $\textbf{er}^{m,n}_{n',u'}$ takes a (dynamic) measurement relation $f$, stores the maximal degrees that $f$ returns for the two correlates $u$ and $u'$ at $n$ and $m$ position, respectively, then requires $n$ exceeds $m$ and checks if the standard maximal degree

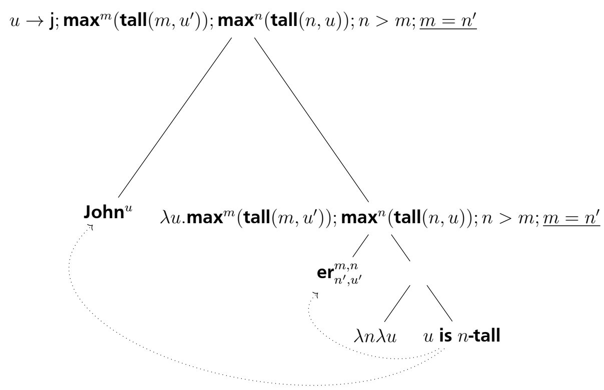



Figure 4.5: Composing the CCP *John is taller*

is identical to a discourse antecedent. Note that nothing important hinges on the particular order between the comparison test $n > m$ and the anaphoric resolution $\underline{m = n'}$ here, we will get the same result with the anaphoric resolution updating the context before the comparison test.

Let's examine this dynamic entry more closely with an example we are already familiar with. The semantic composition of *John is taller*, using the dynamic definitions I've given, is provided below in Figure 4.5. We can see that the structure is exactly the same as before, with the comparative marker taking parasitic scope over the licensing operator, i.e., the subject *John*. At the top node we get the desired CCP, dictating the context to first assign the variable $u$ to John, then introduces the maximal tallness degree of $u'$ (i.e., the comparison correlate that *er* is anaphoric to) and the maximal tallness degree of $u$ (John), imposes the ordering relation between the two maximal degrees, and checks if the standard degree is equal to the antecedent dref of *er*, $n'$. The updates are only defined if there is such an antecedent degree, i.e., the context entails the existence of the maximal measurement of the standard correlate.

One more technical complication. Comparing multiple correlates still requires a generalized entry (190) and successive parasitic scope taking, but the derivation will be a little more complicated than in the static version of the analysis. Because *er*'s licensors now all have the type of a dynamic quantifier ($(\mathcal{V} \to \mathcal{T}) \to \mathcal{T}$), they can't be interpreted in succession without variable abstraction in between. Therefore, we need to let *er*'s multiple licensors move further up and leave a trace of a variable to compose with *er*'s meaning. This is shown in Figure 4.6[2].

(190) $[\![\mathrm{er}^{m,n}_{n',u'_0,\ldots u'_n}]\!]$ :=

$$\lambda f \lambda u_0 \ldots \lambda u_n.\mathbf{max}_m(\exists m; f m u'_0 \ldots u'_n); \mathbf{max}_n(\exists n; f n u_0 \ldots u_n); n > m; \underline{m = n'}$$

$$(\mathcal{V}_{\mathsf{d}} \to \mathcal{V}_{\mathsf{a}_0} \ldots \to \mathcal{V}_{\mathsf{a}_n} \to \mathcal{T}) \to \mathcal{V}_{\mathsf{a}_0} \ldots \to \mathcal{V}_{\mathsf{a}_n} \to \mathcal{T}$$

### 4.4.2 Interpreting the *than*-P first

Let the *than*-P be a conjoined clause, and give *than* the meaning in (191): it conjoins two CCPs and let the context to first update with the CCP denoted by its first argument, i.e., the *than*-P.

(191) $[\![\mathrm{than}]\!]$ := $\lambda q \lambda p.q; p$ $\qquad \mathcal{T} \to \mathcal{T} \to \mathcal{T}$

As a demonstration, Figure 4.7 gives the derivation tree of *John is taller than Mary is* with semantic annotations. The updates we get at the top node are visualized in Figure 4.8: the complement of *than* updates the context first, introducing Mary and her height; then the "matrix" comparative clause is interpreted, introducing Mary's height again as a different variable $m$, and John and his height, and testing if John's height exceeds $m$. Finally, the anaphoric resolution checks if $m$ can find an antecedent.

Since *er*'s anaphoric resolution is only interpreted after the *than*-P has already updated the context, introducing Mary and her height, these discourse referents thus can bind *er*'s implicit arguments without a problem. No exceptional scoping or any

[2] All of these special syntactic requirements – tucking-in, and cyclic scope-taking – will no longer be needed in the version of the analysis in chapter 5.

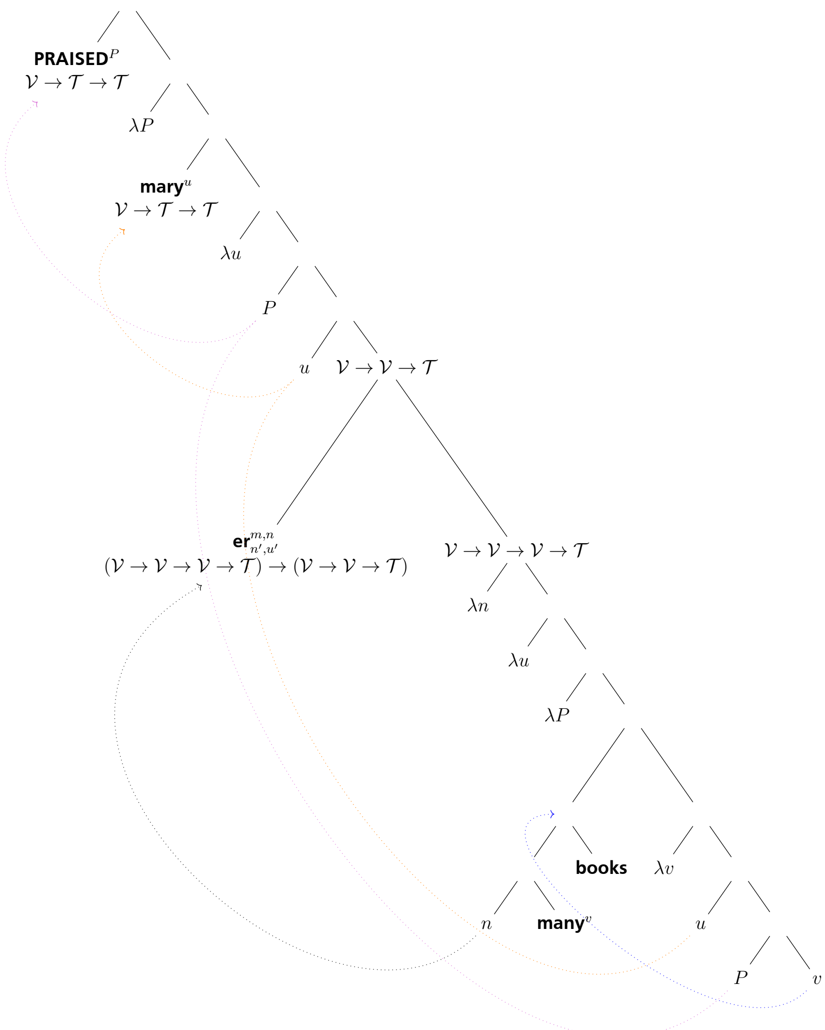



Figure 4.6: Multiple correlates and cyclic scope-taking of the licensors

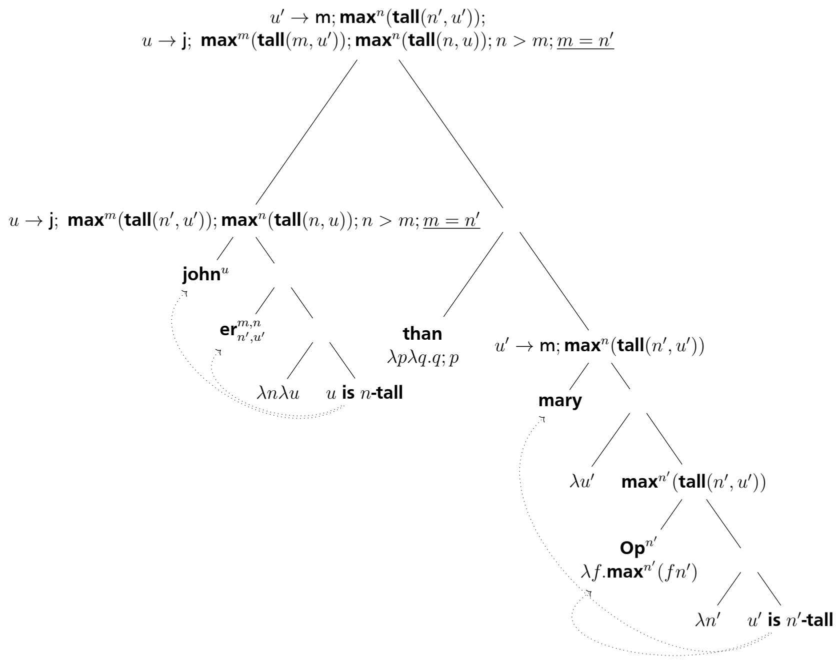



Figure 4.7: Composing *John is taller than Mary is* with order-switching *than*

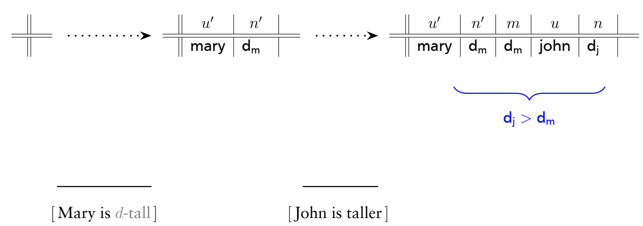



Figure 4.8: Updates of *John is taller than Mary is* with order-switching *than*

kind of LF movement needed – after the interpretation order is switched, this is just standard dynamic binding.

The analysis can also extend to those clausal comparative that, at first glance, appear that could only be comparing degrees. These are comparatives with the existential *there* construction, such as *there are more cats than there are dogs*. With the current lexical entry of *er*, this comparative construction should be analyzed as a comparison between alternative predicates, *cats* and *dogs*. The complete derivation with semantic annotations is shown in Figure 4.9: the predicate *cats* takes scope to

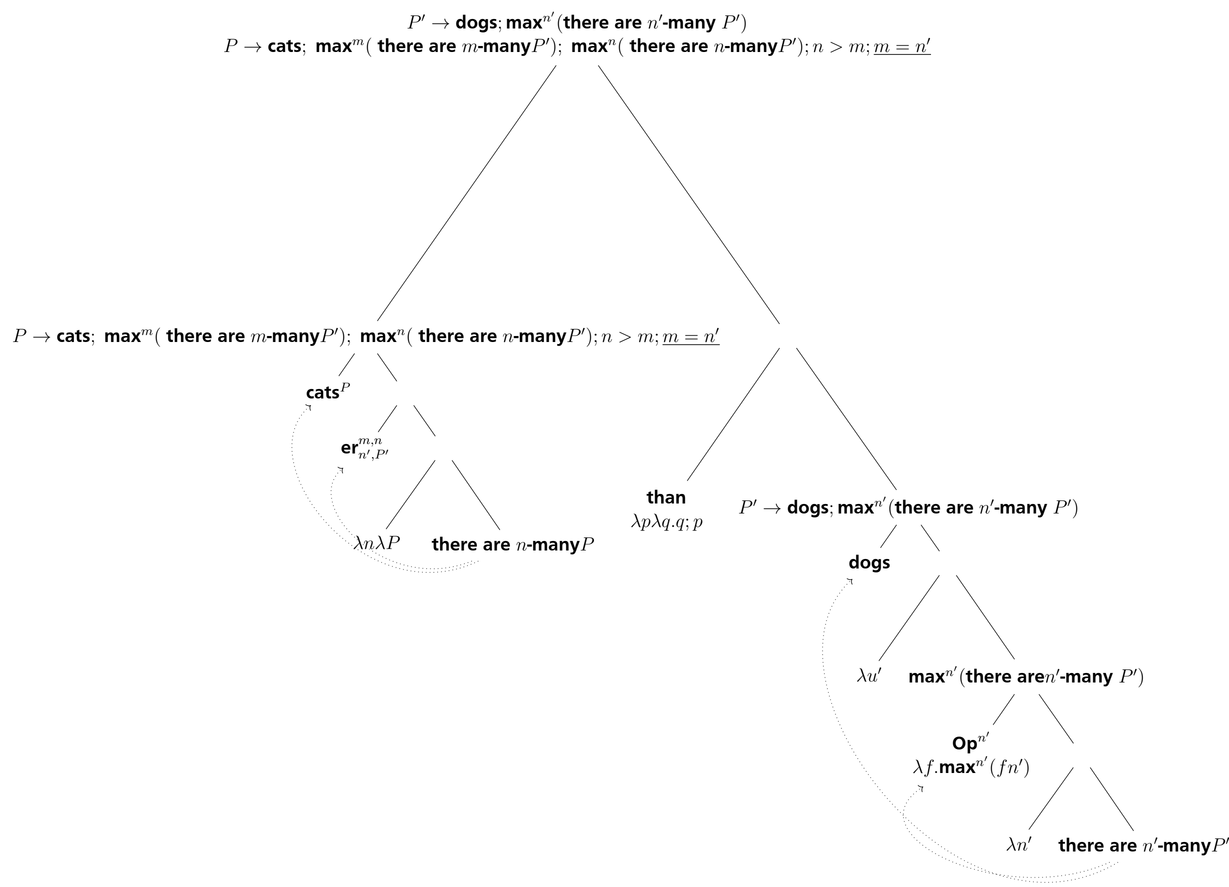



Figure 4.9: Composing *there are more cats than there are dogs* with order-switching *than*

license the use of *er* in the matrix clause, and the meaning we derive at the top node says that the maximal amount of cats there are is larger than the amount of dogs there are.

### 4.4.3 Generating different explicit comparative constructions

This dynamic analysis can be generalized to all kinds of comparative constructions, with the implication that the *than*-P is *uniformly* a coordinated clause in all kinds of comparative constructions. Those that are not obviously clausal must have undergone surface reductions.

The phrasal comparative *John is taller than Mary* thus must have the underlying structure in (192) (cf. Lechner 2001, Lechner 2004, Bhatt and Takahashi 2007 for arguments defending an ellipsis approach to phrasal comparatives in English), same as its clausal counterpart in Figure 4.8. The interpretation will be on a par with its clausal comparative.

(192) $[\text{John}^{u}\,[\text{er}^{v,m,n}_{n',u'}\;\lambda n \lambda u$
$[\,[\,[\,u\,\text{is}\,n\text{-tall}\,]\,][\,\text{than}\,[\text{Mary}^{u'}\;\lambda u'[\mathsf{Op}^{n'}_{v}\;\lambda n'[u'\,\text{is}\,n'\text{-tall}\,]\,]\,]\,]\,]\,]\,]$

Yet another kind of comparative construction is the measure phrase comparative, e.g. *John is taller than five feet.*, where the surface complement of *than* is a degree expression, a measure phrase. In order to extend our treatment to these constructions, it's necessary to assume that they, too, have clausal sources. This assumption has been made in different contexts (Bresnan 1973, Hackl 2000, Alrenga and Kennedy 2014), though there is not yet a consensus on what the recovered clausal content should be. Hackl (2000), for example, mention two possibilities: analyzing the measure phrase as the measurement of some possible correlate, as in the paraphrase of (193), or analyzing it as the correlate itself, as in (194). They work equally well here, only in amount comparatives it becomes clear that the first kind of paraphrase is more plausible. For instance, we can take the sentence in (195) (under one reading) to be underlyingly (195a), whereas the paraphrase in (195b) appears to be rather awkward; it is not clear how one can treat *that number* as a correlate in this case.

(193) Bill Gates is taller than five feet.
$\rightsquigarrow$ Bill Gates is taller than somebody who is five feet tall.

(194) This rope is longer than five feet.
$\rightsquigarrow$ This rope is longer than how long five feet is.

Hackl (2000): ex.(124) - (125)

(195) John is required to publish more papers than that number.

a. $\rightsquigarrow$ John is required to publish more papers than somebody who is re-

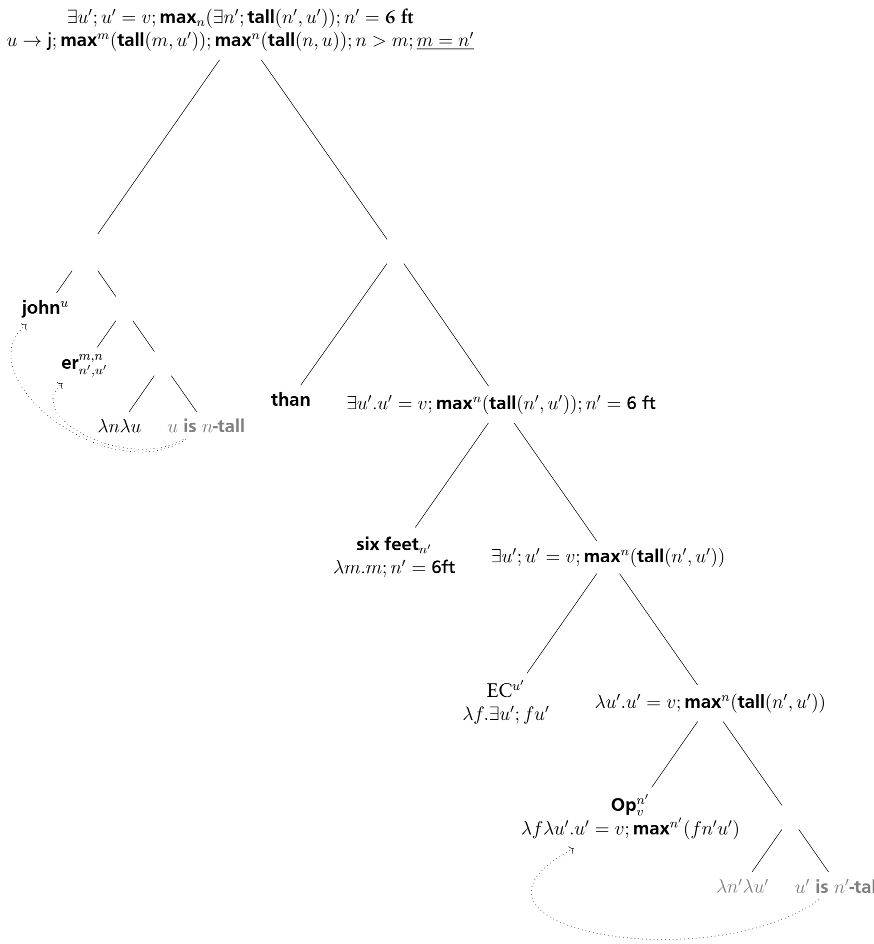



Figure 4.10: Composing *John is taller than six feet*

quired to publish that number of papers.

b. $\rightsquigarrow$ ?? John is required to publish more than how many (papers) that number is.

For this reason, I will take the second option. I assume in measure phrase comparatives, the "explicit" correlate in the *than*-clause is introduced by a silent existential closure EC; the derivation of *John is taller than six feet* is given in Figure 4.10.

Finally, for sentences with comparative quantifiers like *more than three*, I propose the licensing operator of *er* is the parameterized determiner, **many**. I'll assume *many* licenses *er* when it is focused; the focused meaning, $\textbf{MANY}^{u,v}$, takes scope and assigns the normal meaning $\textbf{many}^v$ to be the value of the dref $u$ (197)[3]. I will also assume

[3] Special cautions need to be taken in including drefs referring to info states/assignment functions (

numerals like *three* has the same type of meaning as *many* (198) – they denote a parametrized determiner and usually combine with a covert degree existential closure. When focused, the numeral also introduces a discourse referent that points to its normal semantic value (199).

(196) $\textbf{many}^v := \lambda n \lambda P \lambda Q.\exists v; Pv; Qv; |v| = n$

$$\mathsf{Q} :: \mathcal{V}_\mathsf{d} \to (\mathcal{V}_\mathsf{e} \to \mathcal{T}) \to (\mathcal{V}_\mathsf{e} \to \mathcal{T}) \to \mathcal{T}$$

(197) $\textbf{MANY}^{u,v} := \lambda f.u \to \textbf{many}^v; fu$ $\qquad \mathcal{V}_\mathsf{Q} \to \mathcal{T} \to \mathcal{T}$

(198) $\textbf{three}^v := \lambda n \lambda P \lambda Q.\exists v; Pv; Qv; |v| = n = 3$ $\qquad \mathsf{Q}$

(199) $\textbf{THREE}^v := \lambda f.u \to \textbf{three}^v; fu$ $\qquad \mathcal{V}_\mathsf{Q} \to \mathcal{T} \to \mathcal{T}$

These pieces are put together in Figure 4.11. The readers are welcomed to check that, after cashing out the dref values introduced by $\textbf{MANY}^{u,v}$ and $\textbf{THREE}^{u',v'}$, respectively, the meaning we get at the top node essentially compares two amounts we can draw from the people who left: the maximal amount of people who left, and the maximal amount of *three* people who left (i.e., three) – which is just an elaborated way of comparing the amount of people who left to the number three.

### 4.4.4 Summary

In sum, I propose explicit comparative constructions exhibit another kind of *comparative anaphora*, where the anaphora resolution of *er* is delayed until the *than*-P is interpreted. I have shown in this section that this can be compositionally derived in dynamic semantics, and that that this account can handle the variety of explicit comparative constructions.

Muskens 1995), but the technical difficulties can be circumvented (Hardt 1999, Charlow 2017).

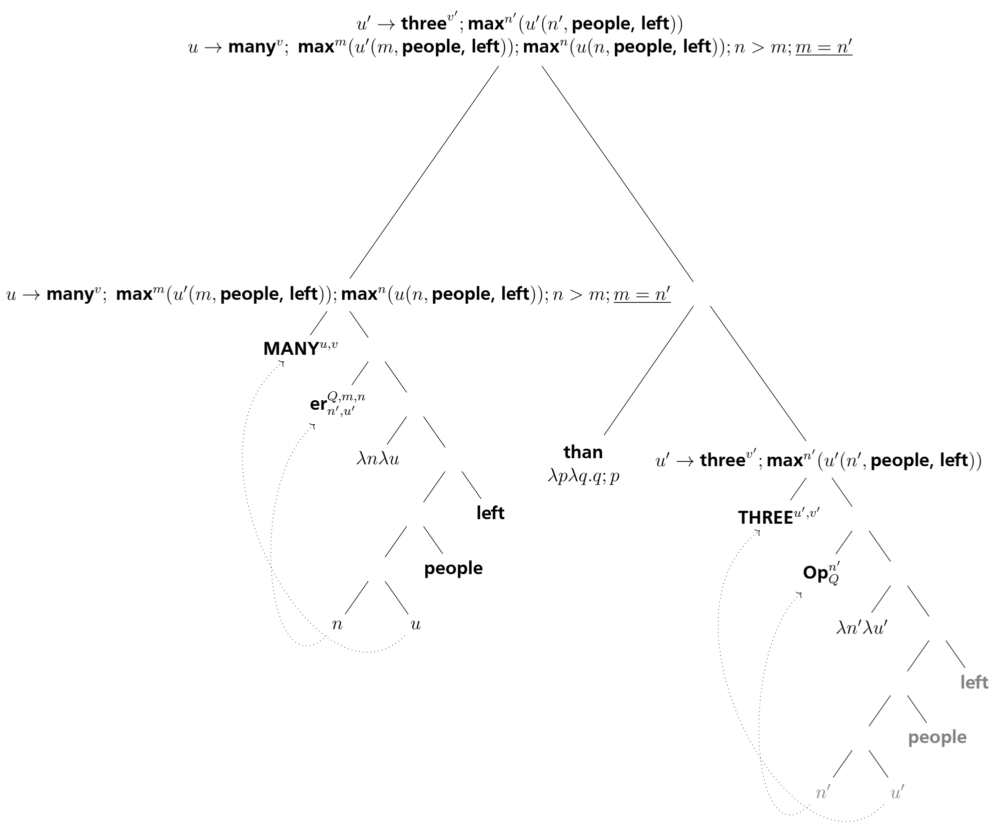



Figure 4.11: Composing *More than three people left*

## 4.5 Parallelism in explicit comparatives

One consequence of the current account is the meaning of the explicit comparative construction directly imposes parallelism between the two clauses, which turns out to be stronger than the parallelism required by the comparative deletion. This stronger requirement resolves two puzzles in this literature.

### 4.5.1 A taller man

The contrast exhibited in (200) - (201), between the attributive and the predicative use of the same comparative adjective, has been a long-standing puzzle. While the predicative use of *taller* is perfectly felicitous, the attributive use in (201) implies that my mom is a man, hence is deviant.

(200) ✓ I have never seen a man taller than my mother.

(201) ?? I have never seen a taller man than my mother.

The underlying issue is usually stated in terms of different ellipsis resolutions: the attributively modified noun *man* has to be interpreted in the *than*-P (203) while the predicative use of the comparative does not force this (202) (cf. Bresnan 1973, a.o.). Nevertheless, nothing in the traditional approach *forces* the ellipsis resolution in (203). Traditional comparative semantics is compatible with the underlying structure in Figure 4.12a, as well as Figure 4.12b, where the antecedent of the ellipsis site is the smaller constituent, i.e., the AP. So we still need to address why Figure 4.12b is, in fact, impossible, and so far as I know no satisfying answer has been given (see discussions in Bresnan 1973, Heim 1985, Gawron 1995, Kennedy 1997, Hackl 2000, a.o.).

(202) a man taller than my mother is $d$-tall

(203) a taller man than my mother is a $d$-tall man

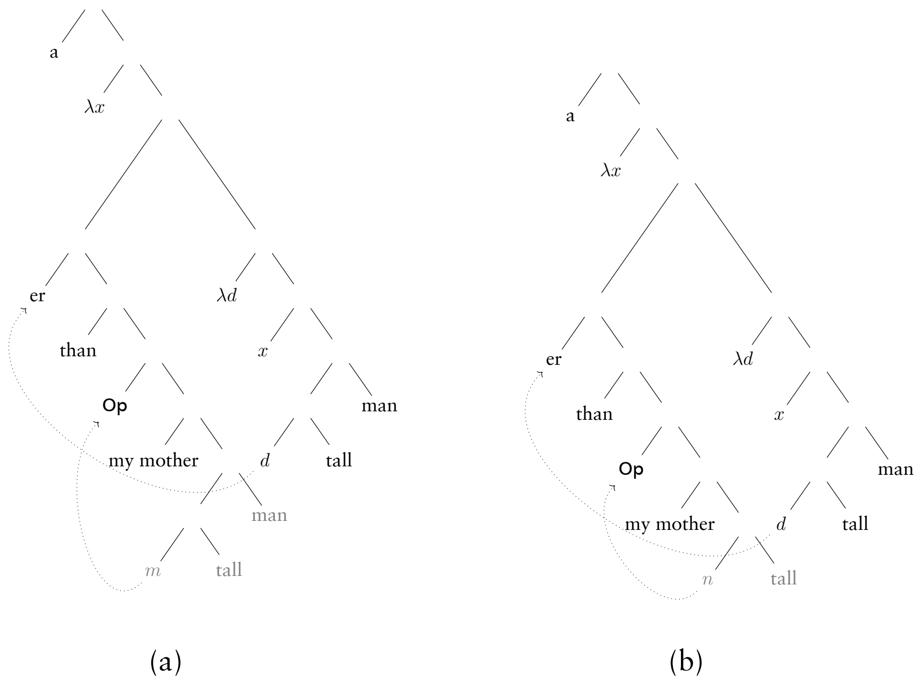
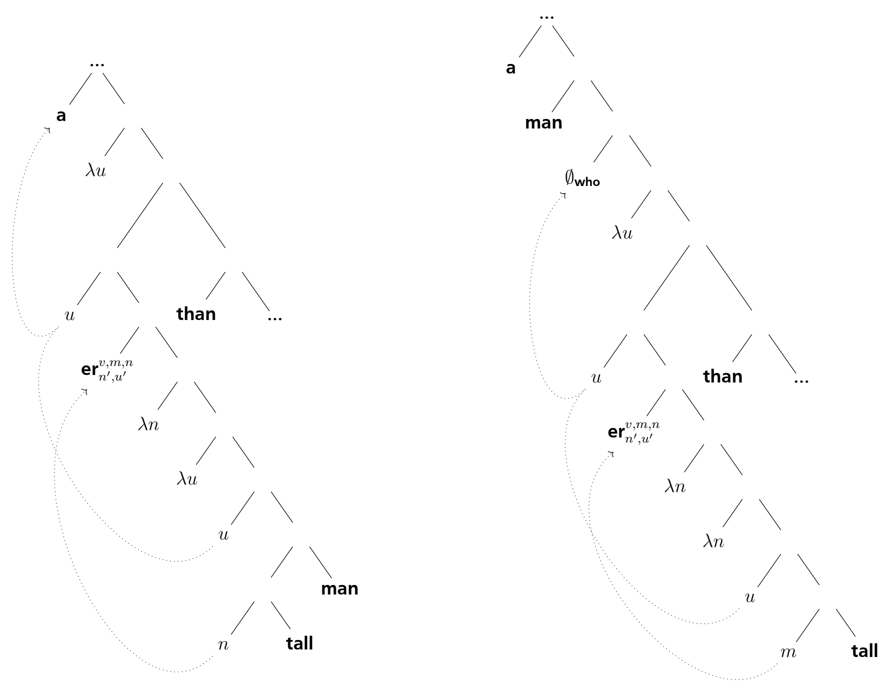



Figure 4.12: Two possible ellipsis resolutions in the traditional analysis

For the current analysis, the contrast is a natural by-product of the difference between attributive and predicative comparatives in the scope of comparison. In the attributive *taller* construction (200), *man* is under the same minimal propositional-type node as *er*'s surface position, which entails that it is in the scope of comparison, however *er* takes scope, and therefore it is either a comparison correlate or part of the measurement function. Neither of these two options works out so well. If it is a correlate, the semantics of the explicit comparative construction dictates us to find an explicit correlate of the same type – a gender noun – in the *than*-P; there isn't one (and it seems impossible to insert one, as *a taller man than my mom woman* is simply ungrammatical). If it is part of the measurement function, such as in Figure 4.13a, then it conditions both correlates of the comparison to be a man. This gives rise to the awkward inference that *my mother* is a man since it obligatorily binds the standard correlate *er* introduces. On the other hand, *man* in (201) is not necessarily in the scope of comparison. Because it is not under the same minimal propositional-type




(a) *a taller man than my mother* (b) *a man taller than my mother*

Figure 4.13: Difference in the scope of comparison

node as the predicative *taller* is, *man* doesn't have to participate in the comparison at all. Figure 4.13b illustrates this with an exemplar derivation, where *er* scopes inside the relative clause and under *man*, generating a comparison between two individuals with no gender specification. In this case, *my mother* can bind the standard correlate without taking up the inference that she is a man.

Of course, the Heimian direct analysis makes the same prediction for phrasal comparatives like (200) and (201) (cf. Heim 1985: section 3.2.2). But because the direct analysis doesn't extend to clausal comparatives, it has nothing to say about the essentially same contrast between (204) and (205). The current analysis generalizes correlate comparisons to all comparative constructions, and therefore correctly predicts that (205) is also deviant because *man* is also forced to be in the scope of comparison in this sentence.

(204) He is a taller man than my Dad is.

(205) ?? He is a taller man than my mom is.

We also predict that it is possible for *man* to be a comparison *correlate* in incomplete comparatives. The only reason it isn't in *a taller man than my mother* is because of the construction – an explicit correlate has to be present in the *than*-P. It should be possible in incomplete comparatives, where the binder can be an (implied) discourse antecedent. And indeed it is, in a suitable context like (206): the comparison is between a man and Mary and no sortal mismatch arises.

(206) Mary/This woman was not up to the task. A stronger MAN was found.

Gawron (1995): ex. (75)

### 4.5.2 Minimal number of participants

As I have briefly mentioned before, Hackl (2000) discovered that sentences like (207a) and (208a) are anomalous, much worse than the truth-conditionally equivalent (if we only consider natural numbers) (207b) and (208b).

(207) a. ?? More than one student are meeting.

b. At least two students are meeting.

(208) a. ?? John separated more than one student.

b. John separated at least two students.

Hackl proposes the anomaly arises because the standard degree in comparative quantifier constructions is not interpreted as a bare degree. Instead, he proposes that *one* in (207a) is interpreted as *an amount of students who are meeting* and in (208a) *an amount of students who John separated*, but *one* is not a possible amount in these situations because it's below the minimal number of participants for meeting or separating.

In order to implement this intuition, we need to find a way to force the verb phrase to be interpreted in the calculation of the standard degree. In the general frames of

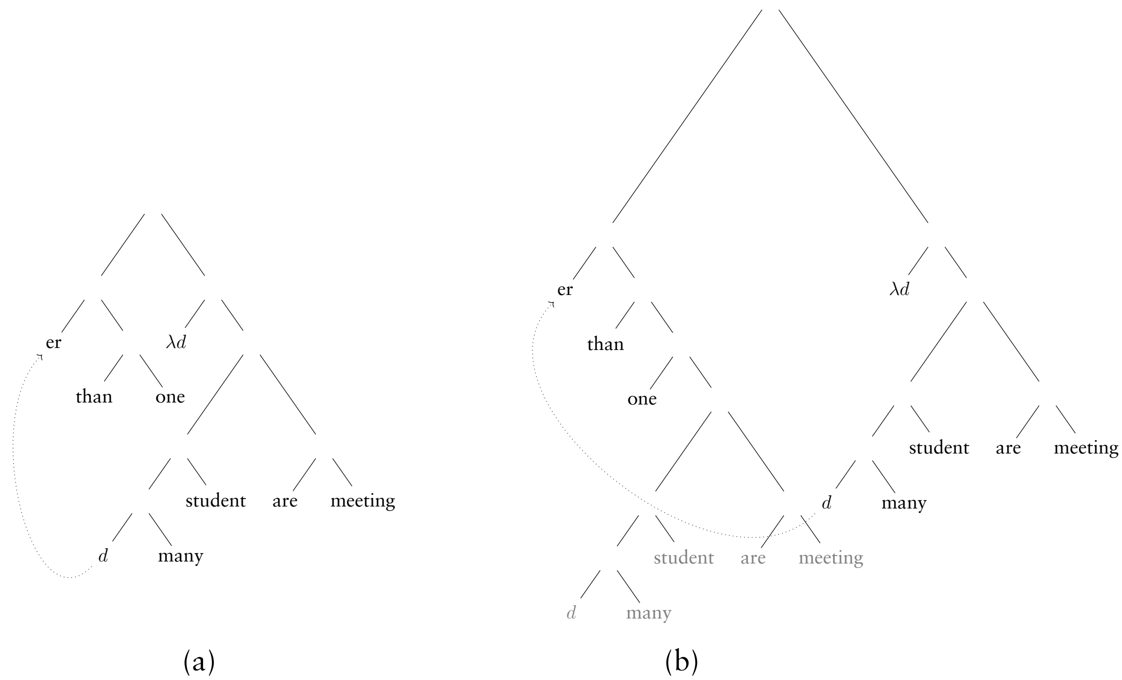



Figure 4.14: Two possible structures of comparative quantifier constructions

the traditional approach, Hackl achieves this in two steps: (1) *many* in the *more* in comparative quantifiers has the meaning of a (parametrized) determiner and hence must take scope over the verb phrase; (2) *many* is interpreted inside the *than*-P. The net result (207a) can only have the structure in Figure 4.14b.

A pillar of the theory has to be stipulated. If *many* doesn't *have to* be interpreted inside the *than*-P, the alternative structure in Figure 4.14a will also be possible, in which the standard degree can be interpreted as a bare degree after all. Yet in the traditional approach, nothing in principle forces *many* to be interpreted in the *than*-P – the structure in Figure 4.14a is just as interpretable as Figure 4.14b.

No such stipulation is necessary in my account. Since both the target and the standard degree are constrained by *er*'s scope argument, the fact that *er* obligatorily takes scope over the verb phrase is enough to make the VP meaning constrain the standard degree. The semantic derivation of (207a) and (208a) will be on a par with my example case *more than three people left* in Figure 4.11, and it should be straightforward to see that we will derive *one* to be the amount of people who are meeting in (207a) and the amount of people who John separated in (208a), which is precisely the desired results.

### 4.5.3 Summary

Both of the two phenomena we've looked at in this section boil down to one issue: what's in the scope of the comparative marker must also be in the complement of *than*. There appears to be no good way of enforcing this in the traditional approach, but in the current analyses it is a natural outcome of the meaning of the comparative construction.

## 4.6 Interpreting quantifiers in the *than*-clause

### 4.6.1 A problem in the traditional approach

In the traditional approach, the *than*-clause denotes either a maximal degree or a degree property whose maximization will be definite[4]. Therefore, a shared consequence of these theories, without further modifications, is that quantifiers interpreted inside the *than*-clause will fall into the scope of the degree maximization. The main problem: for many quantifiers, this predicted default reading is not attested, and we have difficulty deriving the attested reading.

Consider the embedded universal in (209) for example. The default internal reading is (209a), where the standard degree is the maximal tallness degree that every girl reaches, i.e., the height of the shortest girl. Let's call this the narrow scope reading (the quantifier takes narrow scope relative to degree maximization). In reality, (209) doesn't have this reading.

(209) John is taller than every girl is.

[4] There are non-maximility based theories for the *than*-P, using instead negation or universal quantification.

a. $\not\rightsquigarrow$ John's height $> \mathsf{max}\,\{d \mid \forall x \in \mathsf{girl} : \mathsf{tall}(d, x)\}$

b. $\rightsquigarrow \forall x \in \mathsf{girl}$: John's height $> \mathsf{max}\,\{d \mid \mathsf{tall}(d, x)\}$

On the flip side, the reading it does have is the wide scope reading (209b), where the quantifier appears to take scope over degree maximization. The most straightforward way to generate this reading in the traditional approach is to actually have the quantifier take scope over the matrix comparative clause, but this kind of scope-taking immediately raises many concerns (Larson 1988, Schwarzchild and Wilkinson 2002). First of all, the *than*-clause behaves like an island for either overt (210) or covert movemvent (211), so scoping quantifiers outside of the *than*-clause would be a violation of this constraint. Some sentences even require multiple violations to get the desired reading: (212) would involve scoping *most of his children* out of the *than*-clause and out of a conjunct.

(210) *[ Which bird ]$_i$ are you taller than $t_i$ was?

(211) *She asked who was richer than who else was.

Schwarzchild and Wilkinson (2002): ex. (26)

(212) Alice is richer than George$^x$ was and than most of his$_x$ children will ever be.

Second, while Quantifier Raising is usually prohibited from applying to quantifiers like *both* and *usually*, these quantifiers also only have the wide scope reading when inside the *than*-clause (213a) - (213b). To save the analysis of the comparative, this prohibition would have to be relaxed. Similarly, intensional quantifiers like modals and intensional verbs are usually not taken to be syntactically mobile, yet they can also have a wide scope reading when inside the *than*-clause, as exemplified in (213c):

(213) a. Lucy paid more for her suit than they both paid in taxes last year.

b. It is colder in Stony Brook today than it usually is in New Brunswick.

Schwarzchild and Wilkinson (2002): ex. (29)

c. John is more polite than his secretary must/appears to/is reported to have been.

$\rightsquigarrow \forall w \in \mathsf{Acc}_{w_@}$: John is more polite in @ than in $w$.

Heim 2006: ex. (32)

In addition, in order to rule out the impossible narrow scope reading in (209a), we would have to further stipulate that those quantifiers *obligatorily* take scope over the matrix clause. Adding another piece to the puzzle, while the wide scope reading is systematically available for almost all individual quantifiers, it appears to be missing for negative quantifiers like *nobody*[5]. This is shown in (214): if the wide scope reading is available, (214) would have been felicitous (214a), but the sentence is downright ungrammatical.

(214) * John is taller than nobody is.

a. $\not\rightsquigarrow \neg\exists x \in \mathsf{human}$: John's height $> \mathsf{max}\,\{d \mid \mathsf{tall}(d, x)\}$

Ever since these observations have been made, it has become a matter of theoretical urgency to resort to something other than actual wide scope of the quantifier over the comparative clause.

### 4.6.2 Wide scope reading without exceptional scope

An important contributing factor of the quantifier problem is the assumption that the *than*-clause is a semantic argument of *er*. It turns out that, with this assumption being uprooted, the current analysis can straightforwardly interpret *than*-clause internal quantifiers without letting the quantifier take exceptional scope.

The current system works best with embedded existentials. For example, we can

[5]As far as I know, the problem of negative quantifiers was first brought up in Rullmann (1995) as an exemplar case of negative islands in comparatives. For Rullmann, negative islands in comparatives include the infelicity triggered by downward-entailing quantifiers in general. However, not all downward-entailing quantifiers are externally static, so my current analysis has nothing to say about the infelicity in, e.g. *John is taller than fewer than four girls are.*. Unfortunately, I don't have anything to say about these downward entailing quantifiers, and have to leave them to future research.

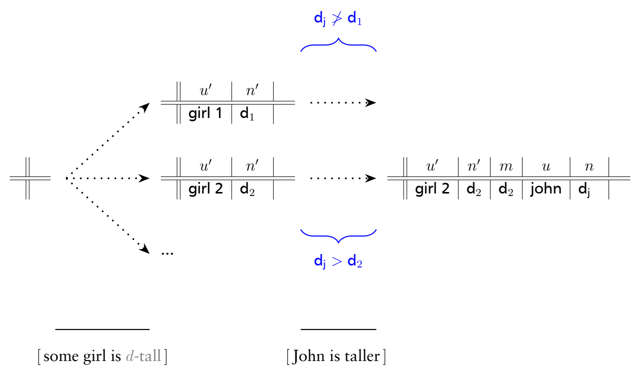



Figure 4.15: Updates of *John is taller than some girl is* with order-switching *than*

generate the desired reading of *John is taller than some girl is* simply by replacing **mary** in Figure 4.7 with **some girl** (defined in (215)); the meaning we arrive at is (216). Roughly, this CCP instructs the context to introduce a random girl and her height to each info state[6], proceed to store John and his height, and check if John's height exceeds the height of *the girl* stored in the same info state. The reading we get is the correct interpretation of the sentence, true as long as there is some girl who is shorter than John (see Figure 4.15) for the visualized updates), who is not necessarily the tallest girl.

(215) $\textbf{some}^{u'}\ \textbf{girl} := \lambda P.\exists u; \textbf{girl}\, u'; Pu$ $\qquad (\mathcal{V} \to \mathcal{T}) \to \mathcal{T}$

(216) [John is taller than some girl is] $\rightsquigarrow$

$$\exists u'; \textbf{girl}\, u'; \textbf{max}^{n'}(\textbf{tall}(n', u'));$$
$$u \to \textbf{j}; \textbf{max}^{m}(\textbf{tall}(m, u')); \textbf{max}^{n}(\textbf{tall}(n, u)); n > m; \underline{m = n'}$$

The reason of this success is that we have replaced the alleged function-argument relationship between *er* and the *than*-clause with anaphoric binding. Since the *than*-clause internal quantifiers (dynamically) bind *er*, they naturally give rise to a wide scope reading.

It is harder to demonstrate this result with non-existential quantifiers using the

[6] I take the singular noun *girl* to contain a cardinality presupposition, and consequently, the girl dref we introduce is presupposed to contain only one girl in each output info state.

current system, partly because in the simplest dynamic framework adopted in this chapter, non-existential quantifiers are externally static. For example, the standard definition of the universal quantifier in CDRT is (217): given an input state $s$, it tests if it is true that each girl has the nuclear scope property; crucially, if it is true, the output is $s$ untouched. All drefs we have temporarily introduced inside the universal quantification are lost in the output, including the girls in the restrictor set of *every*, and cannot be referred back. Therefore, a universal quantifier as defined in (217) can't bind a downstream comparative marker that is outside the universal quantification.

(217) $\textbf{every}^{u'}\ \textbf{girl} := \lambda P \lambda s. \left\{ s \mid \forall x \in \mathsf{girl} : \exists i \in P u' s^{u' \to x} \right\}$ $\quad (\mathcal{V} \to \mathcal{T}) \to \mathcal{T}$

But empirical observations suggest universal quantifiers can't be externally static. In (218), the plural pronouns *they/their* in the second sentence refer to the reference set of *every student*, and when the book read co-varies with the student (i.e., when the indefinite is interpreted in the scope of *every*), the pronoun *it* receives a co-varying interpretation as well: for every student, *it* refers to *the* book bought by that student. In other words, the discourse actually keeps track of the drefs as well as the quantificational dependency introduced in a quantified sentence.

(218) Every$^{u}$ student bought a$^{v}$ book. They$_{u}$ paid for it$_{v}$ with their$_{u}$ credit card.

Phenomena like this can be dealt in an upgraded, *plural* dynamic system, where sentence meanings are modeled as relations between *plural* information states, i.e. sets of information states (van den Berg 1996, Nouwen 2003, Brasoveanu 2007). In systems like this, the universal quantification in (218) outputs sets of info states that store the drefs of students and books in a way that preserves the quantificational dependency, like $G$ in Figure 4.16: each info state in the set stores a student in the restrictor set and the book bought by that student. The subsequent pronoun *they* can refer back to a plural dref, namely the entire column of $u$, which is all the students

| G | ... | $u$ | $v$ |
|---|---|---|---|
| $g_0$ | ... | student 1 | book 1 |
| $g_1$ | ... | student 2 | book 2 |
| $g_2$ | ... | student 3 | book 3 |
| $g_3$ | ... | student 4 | book 4 |

Figure 4.16: An output plural information state of *every student bought a book*

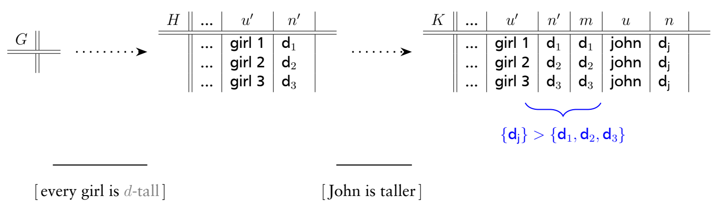



Figure 4.17: Updates of *John is taller than every girl is* with order-switching *than*

in the domain of *every*.

These plural dynamic systems also allow for a direct interpretation of *John is taller than every girl is*. The updates will proceed as sketched in Figure 4.17. We start with the update of the *than*-complement, *every girl is d-tall*, which outputs a set of info states, each stores a girl and her maximal height ($H$ in Figure 4.17). The antecedents of *er* provided in this update are two plural info states, the set of all girls (the $u'$-column of $H$) and the set of all their heights $\{\mathsf{d}_1, \mathsf{d}_2, \mathsf{d}_3\}$ (the $n'$-column of $H$). The updates will return true if, after we proceed to store John and his height, his height exceeds this plural degree. What does this mean? Based on the framework of degree pluralities in Dotlačil and Nouwen (2016) (see more in chapter 5), this can only be interpreted under a cumulative reading of $>$, i.e., it amounts to requiring John's height exceeds each of the girls height ($\{\mathsf{d}_\mathsf{j}\} > \{\mathsf{d}_1, \mathsf{d}_2, \mathsf{d}_3\}$ iff $\mathsf{d}_\mathsf{j} > \mathsf{d}_1, \mathsf{d}_\mathsf{j} > \mathsf{d}_2$, and $\mathsf{d}_\mathsf{j} > \mathsf{d}_3$). This is the wide scope reading that we want.

It shouldn't be hard to see that we can generate the wide scope reading of other kinds of ∃- and ∀-quantifiers in the same way, as they change the context in a way parallel to individual quantifiers (Partee 1973, Brasoveanu 2010, a.o.).

### 4.6.3 Problem with proportional quantifiers

So far so good, but problems arise with quantifiers like *most*.

The meaning of *than* dictates the proposition inside the *than*-clause to be interpreted first, but what does *most girl is d-tall* mean? The problem is that since we have given the covert degree operator inside the *than*-clause, Op, a meaning that just innocently introduces the maximal degree, the nuclear scope of the quantifier is just a property of having a maximal degree. This has worked fine for existential and universal quantifiers (219) - (220), but the result is suspicious for *most girls* (221): the property of having a maximal height is presumably true for just any individuals, so it's strange to use *most* in this quantification, which seems to imply that there are girls who don't have this universal property.

(219) $[\,\text{some girl}\,\lambda u'\,[\,\text{Op}\,\lambda n'\,[\,u' \text{ is } n'\text{-tall}\,]\,]\,] \rightsquigarrow$

$$\textsf{some}(\textsf{girl})(\lambda x.\exists d : x \textsf{ is maximally } d\text{-tall})$$

(220) $[\,\text{every girl}\,\lambda u'\,[\,\text{Op}\,\lambda n'\,[\,u' \text{ is } n'\text{-tall}\,]\,]\,] \rightsquigarrow$

$$\textsf{every}(\textsf{girl})(\lambda x.\exists d : x \textsf{ is maximally } d\text{-tall})$$

(221) $[\,\text{most girl}\,\lambda u'\,[\,\text{Op}\,\lambda n'\,[\,u' \text{ are } n'\text{-tall}\,]\,]\,] \rightsquigarrow$

$$\textsf{most}(\textsf{girls})(\lambda x.\exists d : x \textsf{ are maximally } d\text{-tall}) \;???$$

Can we solve the problem by treating *most but not all* as an implicature, which gets canceled in cases like (221)? Unfortunately, no – it would mean that *some girls are d-tall* updates the context in exactly the same way as *every girl is d-tall*, and consequently provides the exact same antecedents for the subsequent comparative marker. In other words, *John is taller than most girls are* will end up with the same truth condition of *John is taller than every girl is*, requiring John's height to exceed every girl's height. It's clear that this strong reading doesn't exist.

The same issue arises with *a quarter of*, *less than half* – any proportional quantifiers. These quantifiers convey that certain members in their restrictor set do not satisfy the nuclear scope property, whereas the nuclear scope property in the *than*-clause in this analysis (i.e., has a maximal degree on a certain scale) can be universally true for any individual. This not only is strange, but also results in wrong truth conditions, requiring the standard correlates to be the entire restrictor domain of the quantifier.

I should mention that this problem with proportional quantifiers can be solved if these quantifiers still take exceptional scope over the matrix comparative clause. I give a sketch of the derivation of *John is taller than most girls are* in Figure 4.18, where we can see that the result will be (222): what's in the nuclear scope of these quantifiers is no longer a trivial property having a degree, but also the property of being the comparison standard.

(222) $\textbf{most}^{u'}\ \textbf{girls}\ (\lambda u'.\textbf{max}^{n'}(\textbf{tall}(m,u'); u \rightarrow \textsf{j};\ \textbf{max}^{m}(\textbf{tall}(m,u')); \textbf{max}^{n}(\textbf{tall}(n,u));$
$n > m; \underline{m = n'}))$
$\rightsquigarrow \textsf{most}(\textsf{girls})(\lambda x.\exists d : x$ are maximally $d$-tall $\wedge$ John is taller than $x)$

However, by making this move, we will obviously lose the appealing feature of the current account – the interpretation of (at least some) quantifiers will still subject to exceptional scope-taking.

## 4.7 Second proposal

### 4.7.1 Comparative anaphora as postsupposition

The dynamic toolkit provides other possible ways to interpret the meaning of an explicit comparative. I will offer an alternative analysis, which will eventually help us resolve the problem with proportional quantifiers. The gist of the proposal is that instead of letting the interpretation of the *than*-clause precede the entire matrix comparative clause, we delay the evaluation of only the anaphoric part of meaning in the matrix clause.

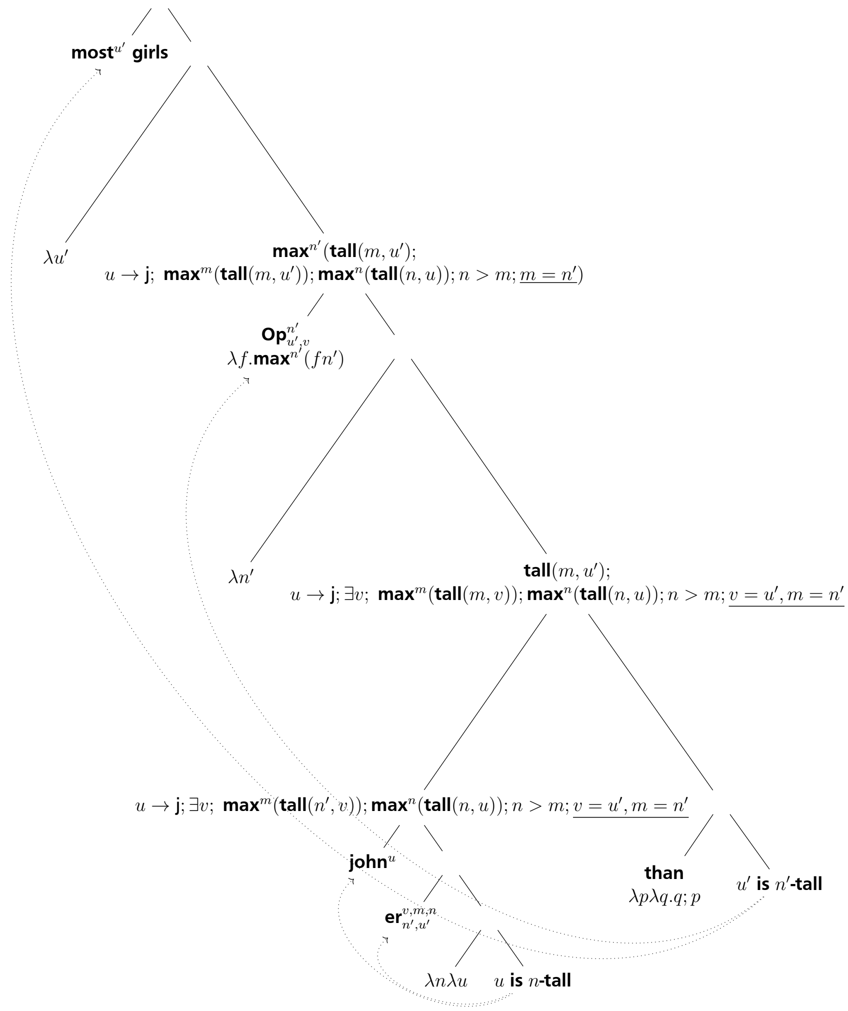



Figure 4.18: Composing *John is taller than most girls are* with order-switching *than*

This requires a slightly different lexical entry of thd comparative marker. First, we can recognize that the dynamic meaning of *er*, in (189), can be rephrased as (223). Instead of directly being anaphoric to a correlate, in(223) *er* first introduces the standard correlate as an indefinite object ($v$), and only resolves its identity to an antecedent later ($\underline{v = u'}$)[7].

(223) $[\text{er}^{v;m;n}_{n',u'}] := \lambda f \lambda u. \underbrace{\exists v; \textbf{max}^m(fmv))\ \textbf{max}^n(fnu); n > m}_{\text{correlate comparison}}; \underbrace{\underline{v = u', m = n'}}_{\text{anaphoric resolution}}$

As the underbraces suggest, (223) shows that the meaning of a dynamic *er* can be decomposed into two parts: a comparison between two (series of) correlates, and an anaphoric resolution of the standard correlate and its corresponding measurement. Yet, because in (223) the two parts are always executed in immediate succession, this decomposition has no real impact on the meaning; apart from introducing an additional variable ($v$), it is essentially equivalent to (189).

This is what we will change in the second step. In dynamic semantics, it is possible to delay the evaluation of certain dynamic tests[8]. Suppose the anaphoric resolution part of *er*'s meaning is such a test, then it can be bound by semantic objects introduced in the *than*-clause without altering the interpretation order of the entire matrix comparative clause: the anaphoric test alone can be delayed to be evaluated after the *than*-clause is interpreted.

Delayed dynamic updates are conventionally called *postsuppositions* in the literature. It has been proposed for a number of distinct phenomena (Lauer 2009, Farkas 2002, Brasoveanu 2012, Charlow 2016, Glass 2020, Kuhn 2022). For instance, postsupposition has been used to deal with sentences containing multiple modified numerals, like (224). The issue is this: standard definition of the modified numeral, (225), results in a non-existing *pseudo-cumulative* reading of the sentence that roughly says the maximal number of movies watched by three boys is five, which is even true in a

[7]Note that this would be a case of Dekker's existential disclosure.

[8]A dynamic test is an update that, if true in an info state $G$, associates $G$ with only $G$ itself.

context where there are other boys who watched movies, in addition to the three boys who watched five movies. This reading is generated because the cardinality tests in the meaning of a modified numeral, with standard definitions like (225), always gets trapped in the scope of another modified numeral's maximization operator. Therefore, it has been noted that the key of ruling out the pseudo-cumulative reading is to somehow let the cardinality tests be evaluated outside the maximization operator (Krifka 1999).

(224) Exactly three boys watched exactly five movies.

(225) $[\text{exactly three}] := \lambda P.\mathbf{max}^u(Pu); |u| = 3$

Brasoveanu (2012) proposes that the problem can be solved by taking the cardinality tests to be postsuppositions. In Brasoveanu's account, this means it is a different type of update (notated using superscripts, (226)): dynamic conditions that are passed on from local context to local context and are only evaluated at the final output context of a sentence, after all the at-issue content has already been evaluated[9]. As a result, the meaning of (224) is now (227a), which is equivalent to (227b), since postsuppositions (in Brasoveanu's account), are always evaluated in the sentence-final output context no matter where they occur on the structure. This gives us the desired cumulative reading of the sentence.

(226) $[\text{exactly three}] := \lambda P.\mathbf{max}^u(Pu);^{|u|=3}$

(227) $[\text{Exactly three boys watched exactly five movies.}] \rightsquigarrow$

a. $\mathbf{max}^u(\mathbf{boy}\, u; \mathbf{max}^v(\mathbf{movie}\, v; \mathbf{watched}(v, u);^{|v=5|}));^{|u|=3}$

b. $\mathbf{max}^u(\mathbf{boy}\, u; \mathbf{max}^v(\mathbf{movie}\, v; \mathbf{watched}(v, u)));^{|v=5|};^{|u|=3}$

There are other possible compositional implementations of delayed dynamic updates

[9] Brasoveanu also proposes that postsuppositions generated inside a distributive quantification can not be passed further on to outside the quantification. This won't matter for our discussions in this dissertation.

(Charlow 2016, Kuhn 2022), but for the purpose of this chapter, Brasoveanu's superscript notation will suffice to demonstrate the main idea, so I will adopt it.

The revised definition I propose for *er* is in (228), with the superscripted $\underline{{}^{v=u',m=n'}}$ indicating the anaphoric resolution is a postsupposition:

(228) $[\,\mathsf{er}^{v,m,n}_{n',u'}\,] := \lambda f \lambda u. \exists v; \mathbf{max}^m(fmv); \mathbf{max}^n(fnu); n > m; \underline{{}^{v=u',m=n'}}$

As a postsupposition, the anaphoric test will be passed on and discharged at the sentence-final output context. While this changes nothing for discourse anaphoric comparatives like *John is taller*, for explicit comparatives this means the anaphoric test is thus delayed to the end of the comparative sentence, after the *than*-clause is interpreted. Therefore we can interpret an explicit comparative construction without any additional operator altering the interpretation order. The composition of *John is taller than Mary is* with this postsuppositional *er* is given in Figure 4.19. Here I assume the standard marker *than* is semantically null (or it simply denotes an identity function).

The meaning we get at the top node, which I repeat in (229a), is equivalent to (229b). Again, they are equivalent because postsuppositions are evaluated at the final output context of the entire sentence. The updates are visualized in Figure 4.20: the context is first updated with a comparison to an indefinite, i.e., we introduce random individuals and keep only those who John is taller than; then the *than*-clause updates the context, introducing Mary and her height $\mathsf{d_m}$; finally, at the final output context, we check if Mary is equal to that individual and her height is equal to that person's height, and returns undefinedness if these equivalence relations don't hold. In other words, for the updates to be defined and true, the comparison must be that John is taller than Mary.

(229) a. $u \to \mathsf{j}; \exists v;\ \mathbf{max}^m(\mathbf{tall}(n', v)); \mathbf{max}^n(\mathbf{tall}(n, u)); n > m; \underline{{}^{v=u',m=n'}};$
$u' \to \mathsf{m}; \mathbf{max}^n(\mathbf{tall}(n', u'))$

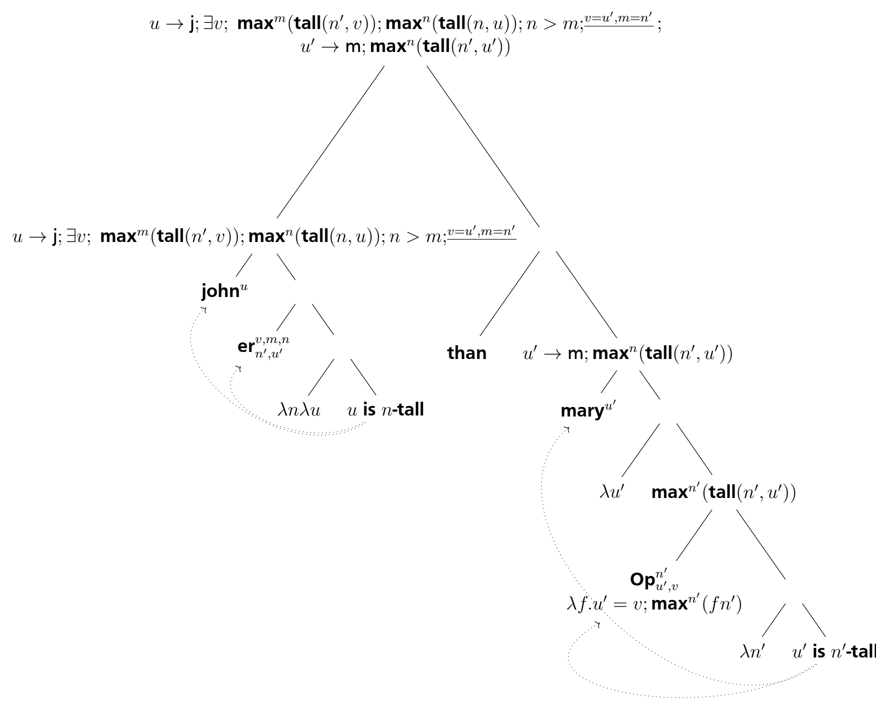



Figure 4.19: Composing *John is taller than Mary is* with postsuppositional *er*

b. $u \to \mathsf{j}; \exists v;\ \mathbf{max}^m(\mathbf{tall}(n', v)); \mathbf{max}^n(\mathbf{tall}(n, u)); n > m;$
$u' \to \mathsf{m}; \mathbf{max}^n(\mathbf{tall}(n', u')); \underline{v{=}u', m{=}n'}$

### 4.7.2 Solving the proportional quantifier problem

We have seen that the first dynamic analysis of explicit comparative constructions in section 4.4 can handle *some* quantifiers inside the *than*-clause in a rather direct way.

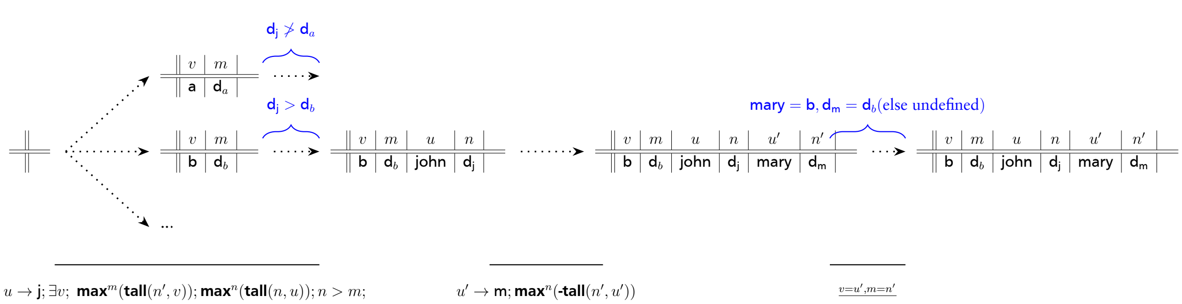



Figure 4.20: Updates of *John is taller than Mary is* with postsuppositional *er*

This is also true for the second, postsuppositional proposal. Moreover, postsuppositional *er* allows us to give the covert degree operator in the *than*-clause a slightly different meaning that solves the problem with proportional quantifiers without appealing to exceptional scope. We thus can provide a complete account of *than*-clause internal quantifiers.

I propose the following re-definition of Op in the *than*-clause:

(230) $\mathbf{Op}^{n'}_{u',v} := \lambda f.u' = v; \mathbf{max}^{n'}(fn)$ $\quad (\mathcal{V}_{\mathsf{d}} \to \mathcal{T}) \to \mathcal{T}$

The two subscripts of Op defined in (230) are for the indefinite correlate *er* introduces ($v$) and for the reference set that the explicit correlate introduces ($u'$), respectively. In addition to introducing the maximal degree as before, this Op also asserts the identity between the two, i.e. that the indefinite correlate and the explicit correlate are identical.

Let's warm up with an existential quantifier to illustrate what has been changed in the interpretation of *than*-clause internal quantifiers. As before, The default interpretation is derived when *some girl* takes scope over the covert maximization operator Op in the *than*-P. I give a detailed derivation tree with semantic annotations in Figure 4.21. The meaning gotten at the top node is equivalent to (231), with the comparative anaphora delayed to the end of the sentence output. The updates are visualized in Figure 4.22: we start with a comparison between John and an indefinite individual, and, instead of resolving that individual to a definite person like Mary, in this sentence it is *asserted* to be identical to the girl introduced by *some girl*. The updates will return true as long as John's height exceeds at least one girl's height.

(231) [John is taller than some girl is] $\rightsquigarrow$

$$u \to \mathbf{j}; \exists v;\ \mathbf{max}^m(\mathbf{tall}(m, u')); \mathbf{max}^n(\mathbf{tall}(n, u)); n > m;$$
$$\exists u'; u' = v; \mathbf{girl}\, u'; \mathbf{max}^{n'}(\mathbf{tall}(n', u'));\underline{{}_{v=u',m=n'}}$$

In plain English, my analysis of *John is taller than Mary* can be paraphrased as *John*

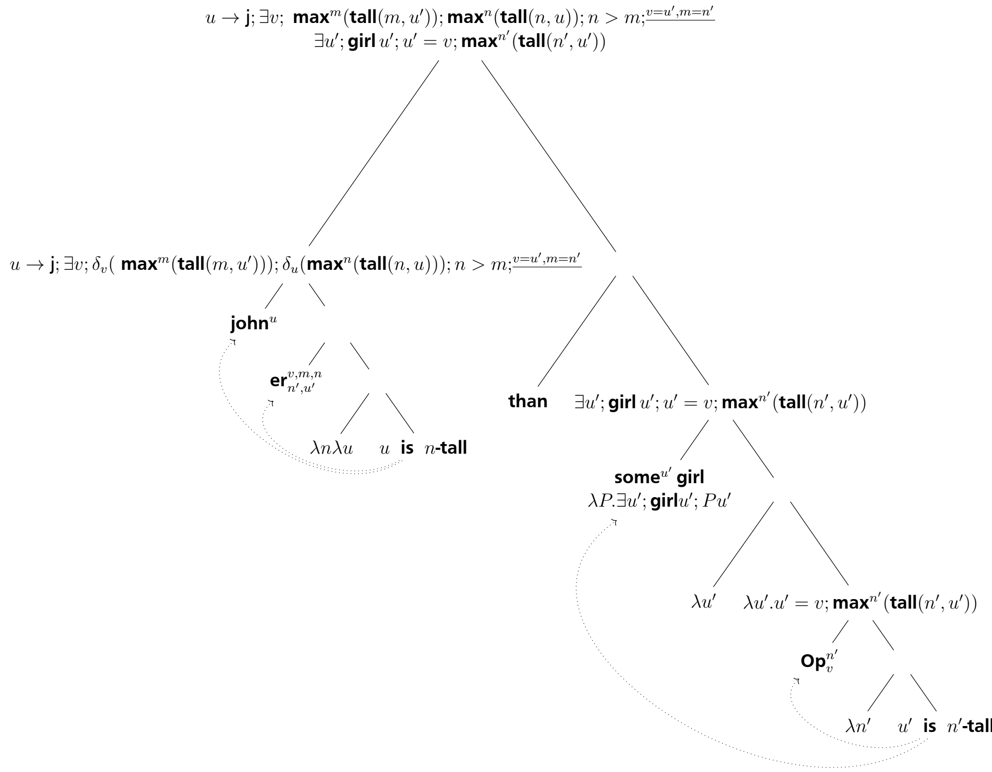



Figure 4.21: Composing *John is taller than some girl is* with the postsuppositional *er*

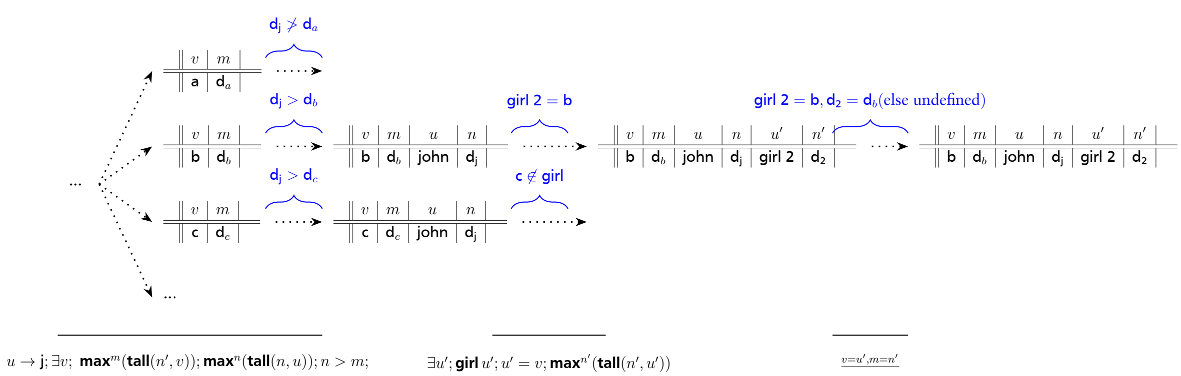



Figure 4.22: Updates of *John is taller than some girl is* with postsuppositional *er*

*is taller than someone, and some girl is that someone*. Note that the identity relation (*that someone is some girl*) is asserted by Op in the *than* clause, in addition to being a presupposed condition of *er*'s anaphoric component. Is this redundant? The answer is no, it has non-trivial consequences when we look at a bigger set of data.

The first consequence concerns the pragmatic licensing condition of co-indexing we've established in chapter 2. We have used this condition to explain why (232) is strange under an anaphoric *more than ten/he criticized* reading: a comparison between what John criticized and what he read is not obviously about any subject matter we can easily construct. However, the explicit comparative construction expressing the same comparison, in (233), is perfectly acceptable. How can we explain this difference without doing violence to the already established pragmatic condition?

(232) John criticized ten books. ... ?? He read (a lot) more.

(233) John read (a lot) more books than he criticized.

It turns out the identity relation asserted by Op could be helpful. With this added assertion, the to-be-resolved comparison is always resolved in a context where the comparison has just been asserted, and hence always relevant. Take (233) for example, the updates contributed by comparative sentence, prior to the postsuppositional anaphoric test, amounts to an assertion that *John read more books than some other activity he's done to books, and criticizing is that other activity*, i.e., a comparison between his reading and criticism. Assuming every assertion $p$ made in the discourse makes the subject matter *whether* $p$ salient, this then means the comparative anaphora is resolved in a context where whether John criticized more or read more is already made relevant to a salient subject matter. Therefore, the co-indexation is pragmatically licensed.

The second consequence is that the nuclear scope property of the quantifier is no longer the universal property of having a degree, but also a property of being identical to the implicit standard in *er*'s comparison:

(234) John is taller than some girl is $\rightsquigarrow$

$\exists v$; John's height $>$ $v$'s height; **some**$^{u'}$(**girl**)($\lambda u'.u' = v; \exists n' : u'$ **is maximally** $n'$**-tall**)

(235) John is taller than every girl is $\rightsquigarrow$

$\exists v$; John's height $>$ $v$'s height; **every**$^{u'}$(**girl**)($\lambda u'.u' = v; \exists n' : u'$ **is maximally** $n'$**-tall**)

(236) John is taller than most girls are $\rightsquigarrow$

$\exists v$; John's height $>$ $v$'s height; **most**$^{u'}$(**girl**)($\lambda u'.u' = v; \exists n' : u'$ **is maximally** $n'$**-tall**)

As the paraphrase in (236) shows, the meaning of *John is taller than most girls are* we now derive says that John is taller than some people, and most of the girls are such that they are identical to those people. The only thing we need for this to be the correct interpretation is an appropriate interpretation of this identity relation: what we want is not most/each of the girls being identical to the same individual, but that there is a one-to-one mapping between the reference set that *most* (or *every*) introduces and people who John is taller than.

This interpretation will be the natural result in a plural dynamic system. In these plural systems like DPlL or PCDRT, the updates of *than most girls are d-tall* will proceed as sketched in Figure 4.23. Crucially, the implicit correlate will be introduced as a plural dref, i.e. {a, d} in $G_0$, {a} in $G_1$, {a, b} in $G_2$, etc., the reference set of *most* will also be introduced as a plural dref, e.g. {girl 1, girl 2} in $G_2$, and the identity relation is imposed on these two sets. The *most*-quantification will output a set of states where the reference set $u'$ constitute most of the (relevant) girls, and the updates will return true if there are any such state (e.g. $H_1$) – in which case it must be true that we can find a majority subgroup of the girls who are identical to a group of people shorter than John, i.e., most of the girls are shorter than John. This is precisely the wide scope reading we want.

In sum, I have provided an account that directly interprets *than*-clause internal quantifiers: the quantifier quantifies over an operator anaphoric to the implicit argument of *er*, which creates the illusion of exceptional scope. Now I will examine the

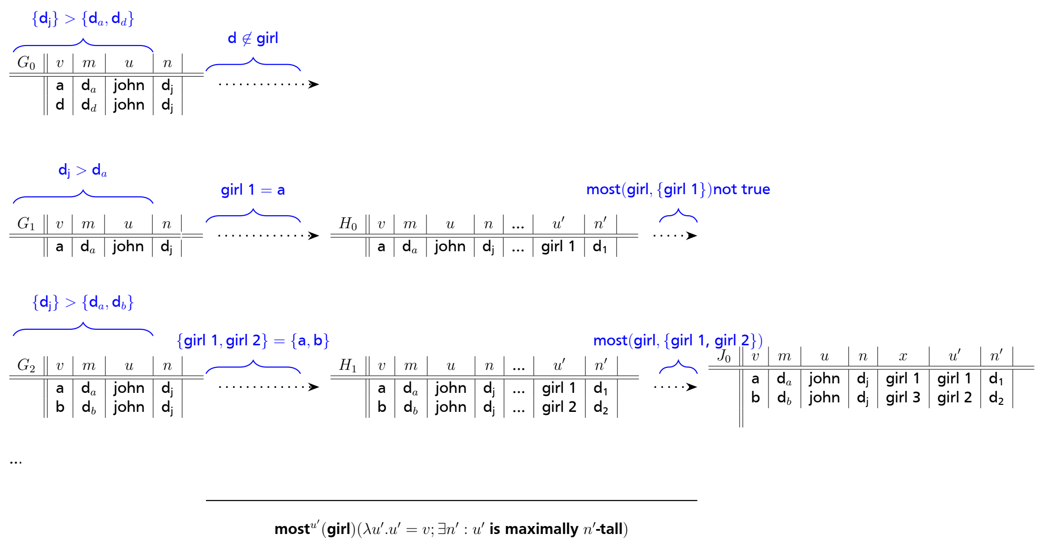



Figure 4.23: Partial updates of *John is taller than most girls are* with postsuppositional *er*

consequences of this proposal in a little more detail, in comparison to the existing theories.

### 4.7.3 Comparing ways to generate the wide scope reading

Negative quantifiers

Heim (2006) proposes a scope-based theory for *than*-clause internal quantifiers (see also a related earlier account in Larson 1988). She posits an operator $\prod$ that maps a degree predicate into a predicate of intervals (i.e., degree sets) (237), and consequently the denotation of the entire *than*-clause into a degree quantifier (238):

(237) $\prod := \lambda D \lambda P.\mathsf{max}P \in D$ $\qquad (\mathsf{d} \to \mathsf{t}) \to (\mathsf{d} \to \mathsf{t}) \to \mathsf{t}$

(238) $[\![$than every girl is $d$-tall$]\!]$

$= [\![\,[\,\text{wh}\ \lambda 2[\,\text{every girl}\ \lambda 3[\prod t_2\,][\,\lambda 1[\,t_3 \text{ is } t_1\text{-tall}\,]\,]\,]\,]\,]\!]$

$= \lambda P.\forall x \in \mathsf{girl} : \mathsf{max}(\lambda d.x \text{ is } d\text{-}\mathsf{tall}) \in P$

$= \lambda P.\forall x \in \mathsf{girl} : x\text{'s height} \in P$ $\qquad (\mathsf{d} \to \mathsf{t}) \to \mathsf{t}$

As a degree quantifier, the entire *than*-clause naturally has to take scope, the result is the widest scope for the *than*-clause internal quantifier:

(239) $[\![\,\text{er}\,]\!] := \lambda d' \lambda d. d > d'$ $\quad\quad$ $\mathsf{d} \to \mathsf{d} \to \mathsf{t}$

(240) $[\![\,[\,[\,[\text{than every girl is } d\text{-tall}\,]\lambda 4[\,[\,\prod[\,\text{er}\, t_4\,]\,]\lambda 5[\,\text{John is}\, t_5\text{-tall}\,]\,]\,]\,]\!]$

$= \forall x \in \textsf{girl} : x\textsf{'s height} \in \{d \mid d > \textsf{john's height}\}$

Heim's theory thus successfully derives the default wide scope reading without having the quantifier take scope outside the *than*-clause. However, by the same token, we should be able to assign a felicitous interpretation to *than*-clause internal quantifiers too (241), true if John is shorter than every girl:

(241) $[\![\,\text{John is taller than no girl is}\,]\!]$

$= \neg\exists x \in \textsf{girl} : x\textsf{'s height} \in \{d \mid d > \textsf{john's height}\}$

As I mentioned earlier, this reading does not exist for clausal comparatives. This is correctly predicted by my current analysis.

The current analysis generates the default wide scope reading for any quantifiers, provided that the quantifier is externally dynamic, i.e. drefs introduced in its scope remains accessible for reference from outside. We have this requirement because the explicit correlate and its corresponding measurement (introduced by Op) need to bind the postsupposed comparative anaphora, and the binding is only possible if the correlate and the degree remain accessible after the *than*-clause has updated the context[10].

[10] A side note: the embedded disjunction in sentences like *John is taller than Mary or Sue is* would be problematic within dynamic frameworks like CDRT or DPL, where disjunctions are also treated as externally static. However, many researchers have argued that disjunctions are actually externally dynamic, as witnessed in (1).

(1) If Mary$^u$ sees John$^v$ or Bill$^v$, she$^v$ waves to him$_v$. Stone (1992): ex. (2)

We can account for embedded disjunctions if we adopt this view (and perhaps attribute the external staticity of disjunctions in certain cases (e.g. *Either I have a*$^u$ *cat or I don't. # He*$_u$ *is adorable*) to illusions created by pragmatic reasons (cf. Rothschild 2017)). An externally dynamic definition of disjunction is given in (2), in which they introduce indeterminacy to the context in a way similar to indefinites do: updating an info state $s$ with the disjunction of two CCPs $p$ and $q$ is equivalent to updating $s$ with $p$ and updating $s$ with **not** $p; q$, and union the results. Correspondingly, the definition of NP disjunction is (3). With this definition, *John is taller than Mary or Sue* receives an indefinite-like wide scope reading, true as long as John's height exceeds one of the girls.

Negative quantifiers are externally static, as exemplified in (242): when *a cat* is in the scope of *nobody* (i.e., it does not refer to a specific cat), it can't have a co-construal reading with the pronoun *he* in the second sentence.

(242) Nobody has a$^u$ cat. # He$_u$ is adorable.

This explains why sentences like *John is taller than nobody is* don't have a felicitous wide scope reading: the clause-external reading in the current analysis requires the degree introduced in the scope of the quantifier to bind *er*'s implicit degree argument, which is impossible for negative quantifiers because of their external staticity.

Note that negative quantifiers in a phrasal comparative are acceptable: *John is taller than nobody* has a perfectly felicitous reading that says John is the shortest person. This difference between phrasal and clausal comparatives is expected if the *than*-clause in a phrasal comparative is not a syntactic island; Indeed, we can observe that movement out of the *than*-clause is generally allowed in a phrasal comparative: the following examples (243) - (244) are in direct contrast with their infelicitous clausal counterpart ((210) - re(211)). If the *than*-clause is not an island, then the wide scope reading of the embedded quantifier in a phrasal comparative can simply be derived by the quantifier taking wide scope over the matrix clause.

(243) [ Which bird ]$_i$ are you taller than $t_i$?

(244) She asked who was richer than who else.

Distributing differentials

A set of the previous theories obviates the negative quantifier problem by still forcing the quantifier to be interpreted in the scope of a higher operator; negative quanti-

(2) $p\,\textsf{\textbf{or}}\,q := \lambda s.s[p] \cup s[\,\textsf{\textbf{not}}\,p; q\,]$ $\qquad \mathcal{T} \to \mathcal{T} \to \mathcal{T}$

(3) $\textsf{\textbf{or}}_{\textsf{np}} := \lambda P \lambda Q \lambda f \lambda s.s[Pf] \cup s[\textsf{\textbf{not}}\,Pf \wedge Qf]$ $\qquad \textsf{a} \to \textsf{a} \to (\textsf{a} \to \mathcal{T}) \to \mathcal{T}$

(4) John is taller than Mary or Sue is. (But I forgot who.) $\rightsquigarrow$

a. $\exists v$; John's height $> v$'s height; $(\exists u'; u' = \textsf{mary} = v)\textsf{\textbf{or}}(\exists u'; u' = \textsf{sue} = v)$

b. $\exists x \in \{\textsf{mary, sue}\}$: John's height $> \textsf{max}\,\{d \mid \textsf{tall}(d, x)\}$

fiers are predicted to be problematic because they lead to a not well-defined maximum or an uninformative statement. However, a subset of these theories (Gajewski 2008, Schwarzschild 2008, Rooij *et al.* 2008, Beck 2010, Alrenga and Kennedy 2014), which I will follow Fleisher (2016) and call them the encapsulation theories, has their own disadvantages in dealing with differential phrases.

The encapsulation theories have the design feature that the *than*-clause serves up one single degree as the standard degree, thus the degrees associated with the quantifiers inside the *than*-clause is *not* distributed over the matrix comparison relation. For an embedded universal quantifier, this one standard degree is the degree corresponding to the top-ranked individual on the relevant scale in the quantifier's domain (245).

(245) *John is taller than every girl is.* $\rightsquigarrow$
John's height > the tallest girl's height

Although the above truth conditions in (245) come out correctly, it has been noted before that the success can't carry over to sentences with more elaborated differentials. For starters, the MAX-reading so characterized in (246) fails to account for the fact that this sentence entails every girl has the same height. To be clear, encapsulation theorists are aware of this problem and have proposed possible fixes, but their fixes still won't explain the entailingness pattern of downward-entailing differentials, e.g. (247) entails that the height difference between John and every girl is less than five inches (see Dotlačil and Nouwen 2016 and Fleisher 2016 for detailed discussions).

(246) *John is exactly five inches taller than every girl is.* $\rightsquigarrow$
John's height = the tallest girl's height + exactly five inches ???

(247) *John is less than five inches taller than every girl is.* $\rightsquigarrow$
John's height = the tallest girl's height + less than five inches ???

On the other hand, in theories where the comparison relation is interpreted distributively, these entailments that come with differentials are naturally predicted. This puts this group of theories at an advantage in this regard, which includes my current proposal.

### 4.7.4 Narrow-scope readings

Possible Constraints on over-generations

Like previous theories that allow for an extra scopal element inside the *than*-clause, the current analysis can, in principle, can have the embedded quantifier interpreted in the scope of degree maximization. It has been argued that this possibility of having narrow scope reading gives rise to massive over-generations, but I'll argue that our analysis can potentially prevent some of them.

I'll use Heim (2006) to demonstrate the over-generation problem in previous scope-based theories (see also Gajewski 2008, Schwarzschild 2008, Rooij *et al.* 2008, which, in spite of very different implementations, produce the same results.). The theory derives a narrow scope reading for the embedded universal in *John is taller than every girl is* when the $\prod$ operator inside the *than*-clause scopes over the universal (248). This is a reading that says John's height falls into the degree that the shortest girl reaches, i.e. John is taller than the shortest girl; not a possible reading. It's easy to see that the same problem extends to *any* distributive quantifiers in the *than*-clause, be it the epistemic universal modal, adverb of quantification, or attitude verbs.

(248) $[\![\text{ than every girl is } d\text{-tall }]\!]$
$= [\![\,[\text{ wh } \lambda 2[\prod t_2\,][\,\lambda 1[\text{ every girl is } t_1\text{-tall}\,]\,]\,]\,]\!]$
$= \lambda P.\mathsf{max}(\lambda d.\forall x \in \mathsf{girl} : x \;\mathsf{is}\; d\text{-}\mathsf{tall}) \in P$
$= \lambda P.\text{the height of the shortest girl} \in P$ $\qquad (\mathsf{d} \to \mathsf{t}) \to \mathsf{t}$

The current analysis also generates a narrow scope reading when the embedded Op (i.e., degree maximization) scopes over the embedded *every*. How can this happen? In the current analysis, *er* is free to compare two (series of) correlates of any type, so nothing prevents us from generating a comparison between higher-typed correlates, e.g., alternative (dynamic) quantifiers.

In my analysis, *er* takes scope between a licensing operator $Q$ and its trace, the type of the trace is the type of things under comparison; therefore, comparing alternative quantifiers can only happen when *er* takes scope over a quantifier-type trace. We have already seen something like this in the composition of comparative quantifiers like *more than three*, where *more* needs to compare two (parametrized) determiners **many** and **three** (Figure 4.11). The same compositional tools can be used to generate a higher-order comparison in *John is taller than every girl is*. Let **Q′** abbreviate the type of a standard dynamic (individual) quantifier like $\textbf{john}^u$ or $\textbf{every}^{u'}$ **girl**, i.e., $(\mathcal{V}_{\mathsf{e}} \to \mathcal{T}) \to \mathcal{T}$, we can give *John* and *every girl* the higher-order meaning in (249) and (250): these higher-order dynamic quantifiers leave a higher-order trace and introduce drefs of dynamic quantifiers in their scope position (cf. Cresti 1995, Sternefeld 2001, Charlow 2016).

(249) $\textbf{JOHN}^{P,u} := \lambda c.P \to \textbf{john}^u; cP$ $\qquad (\mathcal{V}_{\mathsf{Q'}} \to \mathcal{T}) \to \mathcal{T}$

(250) $\textbf{every}^{P,u'}\ \textbf{girl} := \lambda c.P \to \textbf{every}^{u'}\ \textbf{girl}; cP$ $\qquad (\mathcal{V}_{\mathsf{Q'}} \to \mathcal{T}) \to \mathcal{T}$

An exemplar derivation with *er* taking scope to compare the higher-order trace left behind is given in Figure 4.24. With this structure, the matrix comparative clause generates a comparison between two alternative quantifiers, while the implicit correlate resolves to the quantifier $\textbf{every}^{u'}$ **girl**. Since the degree maximizing operators, **er** and **Op**, scope over the quantifier-type trace, the degrees we compare are results of maximizing over the normal type dynamic quantifiers $\textbf{john}^u$ and $\textbf{every}^{u'}$ **girl**. The meaning we get is roughly (251) (skipping the irrelevant anaphoric test here), which in turn comes down to (252): a comparison between John's height and the result of a dynamic degree maximization over a universal quantifier.

(251) $P \to \textbf{john}^u; \exists Q; \textbf{max}^m(Q(\lambda u.u\ \textbf{is}\ m\textbf{-tall})); \textbf{max}^n(P(\lambda u.u\ \textbf{is}\ n\textbf{-tall})); n > m$

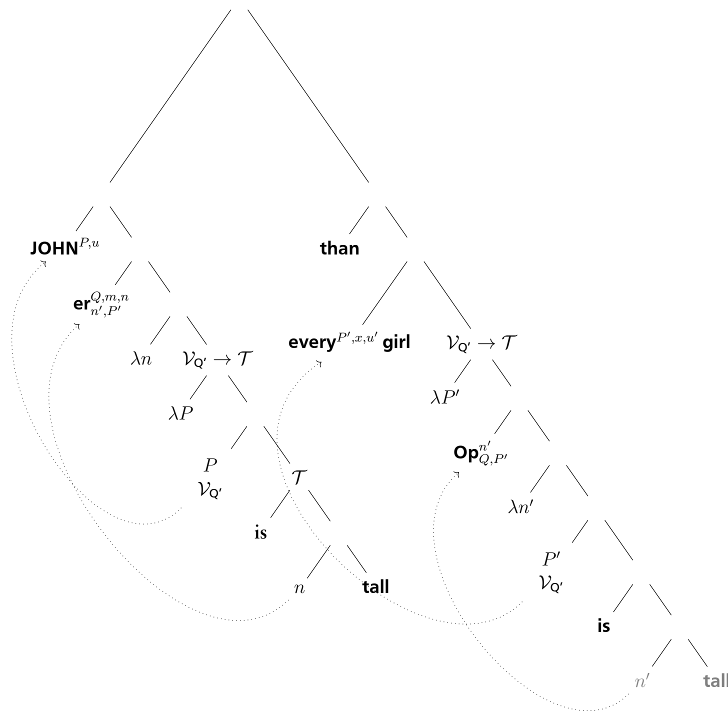



Figure 4.24: Composing *John is taller than every girl is* with higher-order alternatives

$$P' \to \textbf{every}^{u'}\ \textbf{girl}; \textbf{max}^{n'}(P' = Q; P'(\lambda u'.u' \textbf{is}\ n'\textbf{-tall}))$$

(252) $\rightsquigarrow \textbf{max}^{m}(\textbf{every}^{u'}\textbf{girl}(\lambda u'.u'\ \textbf{is}\ m\textbf{-tall})); \textbf{max}^{n}(\textbf{john}^{u}(\lambda u.u\ \textbf{is}\ n\textbf{-tall})); n > m$

Whether this is the unwanted more-than-minimum reading, as in Heim's theory, depends on what the result of the degree maximization over an universal is, i.e. after we let the context update with the CCP in (253), what the maximal value of $m$ is. It turns out that at least in a certain plural dynamic system, i.e. PCDRT, this does *not* give us the height of the shortest girl, and the narrow scope reading we will derive (in PCDRT), for the embedded universal, is actually the same as the wide scope reading[11].

(253) $\exists m; \textbf{every}^{u'}\textbf{girl}(\lambda u'.u'\ \textbf{is}\ m\textbf{-tall})$

To illustrate this, let's assume the quantification domain of *every* contains three

[11]The result might be different in other plural dynamic systems. For example, in DPlL, because the introduction of a plural dref is defined differently from PCDRT, states like $J_1$ cannot be straightforwardly generated. I refer interested readers for more detailed discussions in van den Berg (1996) to compare.

girls whose heights are 5'4", 5'6", and 5'8", respectively. In PCDRT, the scope update of the degree maximization, i.e. (253), then proceeds as in Figure 4.25. We first assign random degree pluralities into the info state, then introduce the maximal set of girls such that for each girl-assignment, the corresponding degree assignment (in the same row) is a height that she reaches; the updates finally outputs a set of plural states where such maximal girl set is a superset of all the relevant girls. We can see from Figure 4.25 that states $K_0$ and $K_1$ are in the output: in $K_1$, the degree assignment is the shortest girl's height, and indeed the girl in every row reaches that height; in $K_0$, however, the degree assignment is the plural degree containing the three girls' height, {5,4", 5'6", 5'8"}, yet still, in every row it is true that the girl reaches the height degree *in that row*. Now when we maximize the value of $m$ out of these states in the output, the result can't be {5,4"}, since it is obviously a lesser degree than {5,4", 5'6", 5'8"}; it should be {5,4", 5'6", 5'8"} ($K_0$). Therefore, the alternative quantifier comparison comes down to a comparison between John's height and this plural degree again, which is true if John's height exceeds 5,4", 5'6", and 5'8", i.e. for every girl he's taller than her[12].

[12] I hasten to add that there is at least one group of universal quantifiers that seems to induce a more-than-minimum interpretation. These are modal verbs like *require*, *need to/have to*, etc.. For example, in the context of (1), the sentence *He (Chuck) is taller than he is required to be* can be ambiguous between two readings: one that says Chuck's height exceeds 6'5" (1a), and another one saying Chuck's height exceeds 5'4", the minimum of the acceptable heights (1b). The latter is a more-than-minimum interpretation.

(1) (Context: Air Force regulations require all pilots to be 5'4" – 6'5" tall.)[13]

a. (Lucky for Chuck,) he is taller than he is required to be.
$\rightsquigarrow \mathsf{max}\,\{d \mid \text{Chuck is } d\text{-tall in } w_@\}$
$> \mathsf{max}\,\{d \mid \exists w \in \mathsf{Acc}_{w_@} : \text{Chuck is } d\text{-tall in } w\}$

b. (Chuck is really too tall,) he is taller than he is required to be.
$\rightsquigarrow \mathsf{max}\,\{d \mid \text{Chuck is } d\text{-tall in } w_@\}$
$> \mathsf{max}\,\{d \mid \exists w \in \mathsf{Acc}_{w_@} : \text{Chuck is } d\text{-tall in } w\}$

In the PCDRT implementation, we will lose the ability to generate this ambiguity as a simple scope ambiguity, since now degree maximization under or over the embedded universal will deliver the same result. However, it is noticeable that this ambiguity is limited to only a subset of modal verbs, and therefore it is conceivable that the more-than-minimum interpretation in (1b) is generated through other means than scope. I refer interested readers to Meier (2002), Krasikova (2008) for two possible alternative approaches, and Beck (2010), Dotlačil and Nouwen (2016) for more concrete implementations.

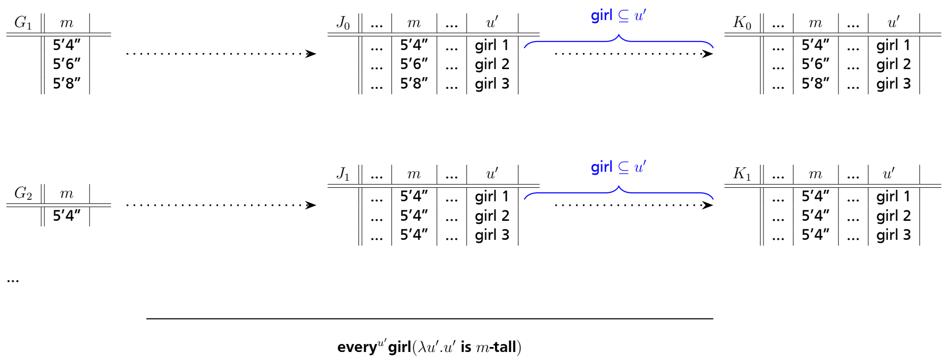



Figure 4.25: Scope of degree maximization over an embedded universal in PCDRT

The same result extends to some other generalized quantifiers like *most*: the result of dynamic degree maximization over *most girls* is a plural degree that contains the height of most girls (not the degree of the shortest girl among a majority group as in Heim's theory); comparing John's height to this plural degree derives the truth condition that for each girl in a majority subgroup of girls, John is taller than her.

Interestingly, the result we have gotten here coincides with the prevailing idea in this literature since Schwarzchild and Wilkinson (2002), namely that solving the problem of *than*-clause internal quantifiers requires the computation of degree intervals (i.e. degree sets) at some point; same as in many previous works with this intuition, we get the correct reading of *John is taller than every girl is* because when *every* takes narrow scope, the comparison standard is not the degree of the shortest girl but a set of degrees containing the heights of every girl. One difference is that, in my analysis, we get the desired degree sets without any *ad hoc* postulations, they are natural consequences of the plural dynamic system. This results in more specific differences in the predictions regarding an embedded existential quantifier, which we now turn to. Narrow scope readings of embedded existentials

When an embedded existential quantifier takes narrow scope relative to degree

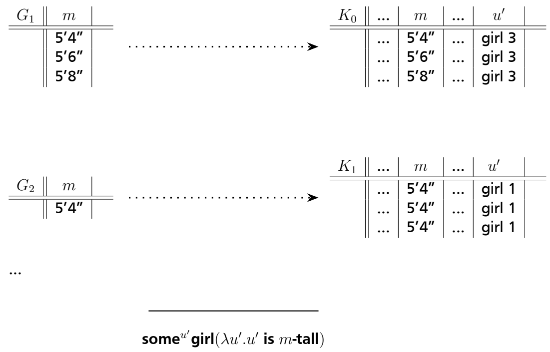



Figure 4.26: Scope of degree maximization over an embedded existential in PCDRT

maximization in my analysis, the result is the same more-than-maximum reading as in Heim's theory.

The reason is because dynamic degree maximization over an embedded existential still delivers the maximum among a set of witnesses, same as in a static framework. For instance, in the maxmization of (2), we let the context update with $\exists m$; **some**$^{u'}$**girl** $(\lambda u'.u'$ **is** $m$**-tall**$)$, which outputs a set of states with $u'$ assigned to a singular girl whose height reaches the $m$-value in that state; this will be the same in either a non-plural or a plural dynamic system (see Figure 4.26 for the PCDRT updates). The maximal $m$-value out of this set will always be the height of the tallest girl. Therefore, we could, in principle, generate a reading of *John is taller than a girl is* that says John is taller than the tallest girl, e.g., by giving *a girl* a higher-order meaning parallel to (250) that allows *er* to take scope over the existential quantifier.

(2) **max**$^m$(**some**$^{u'}$**girl**$(\lambda u'.u'$ **is** $m$**-tall**$)$)

Although this reading may arguably be too strong for *John is taller than a girl is*, some have suggested that it does exist when the restrictor noun phrase is stressed, e.g. in (3). Other existential quantifiers like *any* or disjunctions have also been suggested to induce a more-than-maximum interpretation sometimes, e.g., *John is taller than* *any girl (is)* can be read as John is taller than the tallest girl and *John is taller than Mary or Sue is* has a reading that says John is taller than the taller girl between Mary and Sue (Stechow 1984, a.o., but see Schwarzchild and Wilkinson 2002 for an objection).

(3) Mary lifted more than a BOY did.
⇝ Mary lifted more than the strongest boy. Lassiter (2012), ex. (15)

Putting the controversies in these cases aside, I believe at least the existential quantifier in (4) does have a narrow scope reading. For (4), the wide-scope reading is too weak: it merely requires that one of the airports is closer to John than some random train station. The sentence obviously has the more-than-maximum (i.e., narrow scope) reading, which can be made especially salient by stressing the contrasting noun phrase (TRAIN STATION and *AIRPORT*). Furthermore, with an overt differential phrase inserted into the sentence, *Jafferey is exactly 3 miles closer to an airport than to a train station* entails only that the closest airport is exactly 3 miles closer to Jafferey than the closest train station, it has no entailments regarding the other train stations; this suggests that the sentence has a true more-than-maximum reading.

(4) *Jafferey is closer to an airport than to a train station.* ⇝
Jafferey is closer to the closest airport than to the closest train station.
Lassiter (2012) ex. (17)

While my current analysis can easily generate this more-than-maximum reading as a narrow scope reading of the embedded existential, the same can't be said for the previous theories using degree sets/pluralities.

Beck (2010) generates the more-than-maximum reading at the price of undergenerating the wide scope reading of an embedded existential. Beck adopts Schwarzchild and Wilkinson's (2002) proposal that the denotation of gradable adjectives associates individuals to degree intervals (5). The denotation of the *than*-clause is thus raised to be a set of degree intervals, out of which an additional selection mechanism inside the *than*-clause (6) picks out *the* relevant degree, i.e. the maximal degree in the most informative intervals, to serve as the standard argument of *er*.

(5) $[\![\text{tall}]\!] := \lambda D \lambda x.\mu_{\mathsf{height}}(x) \in D$ $\quad (\mathsf{d} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(6) $\textsc{select} := \lambda D.\textsc{max}_{>}(\textsc{m}_{\textsc{inf}} D)$ $\quad ((\mathsf{d} \to \mathsf{t}) \to \mathsf{t}) \to \mathsf{d}$

$$\textsc{m}_{\textsc{inf}} := \lambda p \lambda D.pD \wedge \neg \exists D' : pD' \wedge D' \neq D \wedge pD' \models_c pD$$

$\textsc{max} :=$ the maximum relative to the $>$ relation on intervals or degrees

$\textsc{max}_{>} := \lambda p.\textsc{max}(\textsc{max}p)$ (the end point of the interval that extends furthest)

(7) $[\![\text{er}]\!] := \lambda d' \lambda d.d > d'$ $\quad \mathsf{d} \to \mathsf{d} \to \mathsf{t}$

The theory thus straightforwardly generates the more-than-maximum interpretation of embedded indefinites. For (4), when SELECT applies to the abstraction over the embedded existential, the most informative interval sets are those that contain the closeness degrees between John and any airports, and from these sets SELECT will eventually pick the maximally close degree, i.e. the closeness degree between John and the closest airport. However, it also means the narrow scope reading is the only reading the theory generates for all embedded existential quantifiers, unless the existential receives a specific reading (in which case we may assume the existential force takes widest scope through whatever means that specific indefinites employ).[14][15]

[14] Similar problems arise with other quantifiers with multiple witnesses, e.g. *most*, to get the targeted wide scope reading Beck has to let them take the widest scope too (using choice functions). A concern of this is it might wrongly predict exceptional scope possibilities for these quantifiers that are only observed on indefinites. Additionally, this fix still is unlikely to extend to existential modals, temporal adverbials (*usually*), etc.

[15] Beck claims this is empirically supported, that indefinites inside the *than*-clause indeed can only be ambiguous between a more-than-maximum and a referential interpretation. Yet, in (1) the indefinite does appear to be neither (cf. Dotlačil and Nouwen 2016). (2) makes the same point with the embedded *any*, it clearly has a reading where the condition of my giving money is that your height exceeds at least one of the girls here (which could be made more salient by putting stress on *any*), and it is implausible to give *any girl* a referential reading.

(1) John$^x$ is taller than one of his$_x$ classmates is.

(2) I will give you ten dollars if you turned out to be taller than any girl here.

(8) $[\![$ than [ SELECT $\lambda D$[ John is $D$-close to an airport ]]$]\!]$

= SELECT $(\lambda D.\exists x \in \textsf{airport} : \mu_{\textsf{close}}(\text{John is to } x) \in D)$

$\rightsquigarrow$ the closeness degree between John and the airport closest to him

Other interval-based theories, such as Schwarzchild and Wilkinson (2002) and Dotlačil and Nouwen (2016), have the opposite issue: they only generate the wide scope reading of embedded existential quantifiers across the board. I will illustrate with Dotlačil and Nouwen's theory. Their denotation of adjectives is in (9) (where $\sqsubseteq$ denotes the part-of relation): $[\![$ tall $]\!]$ is inherently plural, it relates an individual to all the degree pluralities that contain that individual's height. We pick out the minimal degree plurality from this set, using the operator MIN, defined in (10). Here $f$ is a variable for choice functions and will be bound by an existential closure at the matrix level. $f$ picks out a random witness of the minimal degrees from the set of minimal degrees; this then becomes the standard degree we feed $[\![$ er $]\!]$.

(9) $[\![$ tall $]\!]$ := $\lambda d \lambda x.\mu_{\textsf{height}}(x) \sqsubseteq d$ $\quad\quad$ $\textsf{d} \rightarrow \textsf{e} \rightarrow \textsf{t}$

(10) MIN := $\lambda D.f(\lambda d.d \in D \wedge \exists d' : d' \in D \wedge d' \in D \wedge d' \neq d \wedge d' \sqsubseteq d)$

$(\textsf{d} \rightarrow \textsf{t}) \rightarrow \textsf{d}$

For the sentence in (11), MIN takes a set of degree pluralities that contain any of the girls heights. Note that there are multiple minimums in this set: e.g. if the girls' heights are 5'4", 5'6", and 5'8", all these three degrees will be the minimums according to the definition in (10), since none is a part of another degree, and MIN will return one of them as the choice of $f$. Eventually, the sentence is true as long as

---

Possible empirical debates about (1) aside, we can at least be certain that the theory's prediction isn't borne out on existential quantifiers in other categories. Beck cited examples with embedded existential modals like *allowed* to show that they do tend to give rise a salient more-than-maximum interpretation, but the same can't be said for existential epistemic modals. A more-than maximum interpretation of the example repeated in (3) would say that today's temperature exceeds the highest possible temperature of tomorrow, i.e. today *must* be hotter than tomorrow. However, this sentence obviously has a weaker reading that merely says today being hotter than tomorrow is *possible*, i.e. the narrow scope reading. It remains unclear how Beck (2010) can handle these cases.

(3) Today is warmer than tomorrow might be.

John is taller than one of the girls.

(11) ⟦John is taller than a girl is⟧

$= \textsf{john is taller than}\ \textsc{min}(\lambda d.\exists x \in \textsf{girl} : \mu_{\textsf{height}}(X) \sqsubseteq d)$

$\rightsquigarrow$ John's height exceeds any of the girl's height

The problem now is that we no longer have the ability to generate the more-than-maximum reading in (4) Just like MIN picks out the height of any random girl in (11), in (12) it picks out the closeness degree of John relative to a random airport as the comparison standard. This is the weaker reading, the stronger reading requiring John to be closer than he is to the closest airport is lost.

(12) ⟦than [ MIN $\lambda d$[John is $d$-close to an airport ]]⟧

$= \textsc{min}\ (\lambda D.\exists x \in \textsf{airport} : \mu_{\textsf{close}}(\text{John is to}\ x\ ) \in D)$

$\rightsquigarrow$ any of the closeness degree between John and an airport

In addition, sentences like (13), where the comparative adjective is used attributively inside an indefinite, are similarly problematic. In this sentence, the argument of MIN is a set of degree pluralities containing the price of any of the presents Carol gave to Betty. Again, MIN will pick out a random minimum of these set, i.e. the price of any of the presents. Therefore, the sentence is predicted to be true as long as Jean gave a present that exceeds the price of *one* present that Carol gave. However, this sentence clearly has a stronger meaning which requires a present Jean gave to Betty to be more expensive than the most expensive present Carol gave to Betty (Gawron 1995).

(13) Jean gave Betty a more expensive present than Carol (did).

(14) ⟦MIN (than Carol gave Betty a $d$-expensive present⟧)

$= \textsf{a present jean gave betty is more expensive than}\ \textsc{min}(\lambda d.\exists x \in \textsf{present} : \mu_{\textsf{price}} \sqsubseteq d \wedge \textsf{gave}(x, \textsf{betty}, \textsf{carol}))$

$\rightsquigarrow$ John gave Betty a present that is more expensive than some present that

Carol gave Betty.

## 4.8 Blocking effect of the overt standard

In addition to resolving the problem with proportional quantifiers, this second analysis also provides an possible solution to a cross-linguistic generalization in terms of CAC ambiguities that we could not have captured with the first analysis.

### 4.8.1 Where the first analysis fails

In all the languages that have been investigated, the presence of an overt standard clause/phrase systematically blocks the ambiguity. *more* can never acquire an additive reading when the *than*-P is present, nor can *noch* co-occur with an *als*-P. We can't account for this blocking effect with the first analysis of the explicit comparative construction. Since the *than*-clause provides antecedents for *er* just as the prior discourse does, there is no reason that *John bought more apples than Mary* can't express the additive meaning, i.e., John and Mary together bought more apples than Mary did.

To demonstrate this more concretely, we need to first make our analysis of comparative ambiguities dynamic. This can be a trivial upgrade:

(15) $\textsf{\textbf{ADD}}_v := \lambda f \lambda u. f(u \oplus v)$[16] $\qquad (\mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}$

(16) $\textsf{\textbf{CONT}}_v := \lambda P \lambda f \lambda Q \lambda u. fu; \underline{Q(P(\lambda n \lambda u. fu; n \leq_f u))} \qquad ((\mathcal{V}_{\mathsf{d}} \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to ((\mathcal{V}_{\mathsf{a}} \to \mathcal{T})) \to (\mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to ((\mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}) \to \mathcal{V}_{\mathsf{a}} \to \mathcal{T}$

With these lexical entries, it is entirely possible to insert **ADD** into the explicit comparative *John bought more apples than Mary*: the structure will be (17) and the interpretation comes out as (18). This says that John and Mary bought more apples than someone, and that someone is Mary, which is exactly the truth conditions of the additive reading. So we will not be able to account for the blocking effect.

[16] For the readers who are worried that $\oplus$ can't apply to two variables, we could define $f(u \oplus v)$ as follows: $\exists z'; z = u \oplus v; fz$ where $z = u \oplus v := \{S \mid S_z = S_u \oplus S_z\}$.

(17) $[\,[\,\text{John}\,[\,\textsf{\textbf{ADD}}_{u'}\,[\,\textsf{\textbf{er}}^{m;n}_{n',u'}\,\lambda u\,[\,u \text{ bought } n\text{-many apples}\,]\,]\,]\,]$
$[\,\text{than}\,[\,\text{Mary}\,\lambda u'\,[\,\textsf{\textbf{Op}}^{n'}\,\lambda n'\,[\,u' \text{ bought } n'\text{-many apples}\,]\,]\,]\,]\,]$

(18) $u' \to \textsf{mary}; \textsf{\textbf{max}}^{n'}(u' \textsf{\textbf{ bought }} n'\textsf{\textbf{-many apples}});$
$u \to \textsf{john}; \textsf{\textbf{max}}^{m}(u' \textsf{\textbf{ bought }} m\textsf{\textbf{-many apples}});$
$\textsf{\textbf{max}}^{n}(u \oplus u' \textsf{\textbf{ bought }} n\textsf{\textbf{-many apples}}); n > m; \underline{m = n'}$

### 4.8.2 Destructive update

With the postsuppositional analysis of the explicit comparative construction, we can now give the covert degree operator a definition that disrupts the anaphoric resolution process in explicit comparative constructions.

In dynamic semantics, it is possible to re-write the value of a certain variable (Vermeulen 1993, Stokhof *et al.* 1996, Charlow 2019, a.o.). For example, in (19), the variable $u$ is initially associated with some linguist by *a*$^u$ *linguist*; but when the second indefinite *a*$^u$ *philosopher* bears the same index, it re-associates $u$ to some philosopher. After this re-association, a subsequent pronoun bearing the index $u$ can only be co-construal with the philosopher, not the linguist. Updates like this that reset the value of a variable are usually called *destructive updates*.

(19) A$^u$ linguist came in. A$^u$ philosopher came in, too. ... She$_u$ sat down at the front.

Destructive updates offers a technical move to formally implement the disruption we need. We can re-define the meaning of the additive operator as in (20). This operator does not directly sum up the target correlate and *er*'s antecedent; instead it is co-indexed with the implicit correlate that *er* introduces as an indefinite object, and, in addition to summing it with the target correlate, this $\textsf{\textbf{ADD}}_v$ also resets the value of the implicit correlate that *er* introduces after the comparative update to be the dummy individual $\star$. The dummy individual is borrowed from van den Berg (1996), which is not in the domain of any lexical relation; when certain variables in an info state are not assigned to any real values, we can think of them as associated with the dummy individual.

(20) $\textbf{ADD}_v := \lambda f \lambda u. f(u \oplus v); v \to \star$ $\qquad (\mathcal{V} \to \mathcal{T}) \to \mathcal{V} \to \mathcal{T}$

$$u \to \star := \lambda S. \left\{ S^{S_u \to \star} \right\}$$

With this new definition, inserting $\textbf{ADD}_v$ in *John bought more apples than Mary* results in the following meaning (still using the structure in (17)):

(21) $u \to \textsf{john}; \exists v; \textbf{max}^m(v \textbf{ bought } m\textbf{-many apples});$
$\textbf{max}^n(u \oplus v \textbf{ bought } n\textbf{-many apples}); n > m; u \to \star$
$u' \to \textsf{mary}; \textbf{max}^{n'}(u' \textbf{ bought } n'\textbf{-many apples}); \underline{v = u', m = n'}$

The only change in (21) is the destructive update marked in blue: after the comparative update asserts that the amount of apples John and Mary bought exceeds the apples bought by the someone stored in the $v$ position, we re-associate the value of $v$ to the dummy individual. Effectively, we have lost track of the indefinite standard correlate in the comparison. Now suppose in an explicit comparative construction *er* is obligatorily co-indexed with the explicit set in the *than*-clause, then after $\textbf{ADD}_v$'s destructive update, the anaphoric resolution is bound to fail: it is impossible to identify the indefinite standard correlate as the explicit correlate in the *than*-clause, as it is impossible for the dummy individual to be identical to, e.g., Mary. The test $\underline{u' = v}$ will always return undefinedness, and so the updates with an overt *than*-P will be necessarily undefined.

### 4.8.3 Discourse dependency of additivity and continuation

Outside of explicit comparatives, the destructive update of $\textbf{ADD}_v$ does not completely free the additive and continuative operators from discourse anaphoricity, because it only trivializes the anaphora requirement of the standard correlate, but not the standard degree.

Consider *John bought more apples*. The translation of the additive reading is (22): the final anaphoric test requires an antecedent identical to $v$ and an antecedent identical to $m$. $v$ is the variable that originally stores the indefinite standard correlate but has been re-assigned to the dummy individual by $\textbf{ADD}_v$ at this point; since we can safely assume every info state contains many variables assigned to the dummy individual (thus enabling modeling information growth as replacing the dummy individual by real referents), this resolution can always be trivially successful. Yet still, the anaphoric condition on $m$, i.e., the variable for the standard measurement used in the comparison, is not trivial. It still is only satisfiable when the prior context already contains the information about the maximal amount of apples *someone* bought. We get similar results for continuative operators. The translation of *it is still raining* is (23): although the anaphoric condition on the correlate $v$ is trivialized, the anaphoric condition on the *degree*, i.e., the maximal no-stronger alternatives of the correlate, is still there.

(22) $u \to \text{john}; \exists v; \textbf{max}^m(v\ \textbf{bought}\ m\textbf{-many apples});$
$\textbf{max}^n(u \oplus v\ \textbf{bought}\ n\textbf{-many apples}); n > m; u \to \star;\underline{{}^{v=u',m=n'}}$

(23) $t \to \text{pres}; \textbf{impf}(\textbf{rain})\, t; \underline{\exists v; \textbf{max}^m(\textbf{impf}(\textbf{rain})\, v; n \leq_{\textbf{impf(rain)}} v);}$
$\underline{(\textbf{max}^n(\textbf{impf}(\textbf{rain})\, (t \oplus v); n \leq_{\textbf{impf(rain)}} (t \oplus v); n > m; u \to \star;}\underline{{}^{v=t',m=n'}}$

It's worth mentioning here that the discourse requirement of *still* seems to be quite weak, unlike the presupposition of *too/again* (Heim 1990, Kripke 2009). For instance, Beck noticed that the use of *still* in (24) is quite acceptable in an out-of-blue context. This might be explainable in my account. In my analysis, the presupposition of this *Tim is still asleep* will be an existential claim (that there is an earlier time he was asleep), followed by the degree anaphora. Neither of these seems to require any additional assumption to accommodate. The existential presupposition should always be satisfiable, since every human being was asleep at a certain earlier time.

As for the degree anaphora, its accommodation only amounts to accommodating the information that this earlier time has a maximal no-stronger alternative, i.e. its maximal sub-interval; every time period has a maximal subinterval, so this should not impose any noticeable condition on the prior discourse, either. Therefore the use of *still* is expected to be acceptable in an out-of-blue context like (24).

(24) A: I want to speak to Tim.
B: He is still asleep. Can you come back later? Beck (2020): ex. (36)

In fact, the degree anaphora in continuative operators in general seems to be easy to accommodate, i.e. that something has a maximal no-stronger alternative on the given property seems to be always true: any individual $x$ has a maximal no-stronger alternative on being tall (all the people who are at least as tall as $x$), any car $x$ has a maximal no-stronger alternative on being a compact car (all the cars that are at least as compact as $x$), etc.. If so, this should mean that the anaphoric condition of continuative operators in general is not really stronger than an existential presupposition, which should explain their difference with *too/again* if the latter's presupposition, as Heim hypothesized, is not merely existential.

### 4.9 Chapter wrap-up

In this chapter, I have shown that the correlate-comparison meaning of *er* motivated in chapter 2 can be developed into a fully compositional account of the explicit comparative construction. The main innovation is that the comparative marker and the overt standard clause are combined together through anaphora, not function application.

In section 4.2, I have explained that the meaning of *er* we have proposed for discourse anaphoric comparatives doesn't work well with the syntax and semantics traditionally assigned to explicit comparatives. The issues can be addressed, however, if we don't think of the *than*-clause as a semantic argument of *er* but a conjoined clause providing the binder of *er*'s implicit arguments.

I have offered two formal implementations of this basic idea, both couched in a dynamic framework. After introducing the formal background in section 4.3, I have presented the first attempt of a dynamic re-characterization of *er*'s meaning in section 4.4, in which the meaning of the *than*-P updates the context before the matrix comparative clause does. I have discussed its advantages in section 4.5 and 4.6. Section 4.5 is about the parallelism observed between the matrix comparative clause and the *than*-clause: it is often observed that elided content in the *than*-clause is required to be identical to the scope of *er* in the matrix clause; while this had to be stipulated in a number of ways in the traditional theories, it is a natural consequence of the current theory. Section 4.6 is about the issue of interpreting quantifiers inside the *than*-clause. The current theory generates natural readings of *than*-clause internal existential and universal quantifiers by default without exceptional scope-taking or any other ad-hoc mechanisms.

I have presented the second, official proposal for explicit comparatives in section 4.7, where the anaphoric component of the comparative marker is treated as a postsupposition, which can be delayed until the *than*-P is interpreted. I have shown that it solves the proportional quantifier problem in the old analysis, thus provides a more comprehensive treatment of *than*-clause internal quantifiers. In section 4.8, I have shown that this proposal combined with a dynamic meaning of the additive operator that wipes out the information about the implicit standard correlate after the additive comparison, the fact that the overt *than*-P blocks CAC ambiguities can be explained.

# CHAPTER 5
# COMPARING ALTERNATIVES IN A PAIR

## 5.1 Introduction

Sentences like (25) have a discourse anaphoric reading where the comparison is made to an aforementioned boat. For instance, in the conversation in (26), *bigger* may compare to Bill's boat, in which case the sentence is true if each year John buys a boat bigger than *that one*. Our current theory of comparatives can generate this reading without a problem.

(25) Every year John buys a bigger boat.

(26) – Bill's boat is very big.
– That's nothing, every year John buys a bigger boat.

With the comparative being in the scope of the lexicalized universal *every*, this sentence also has a reading that is not dependent on any clause-external standard: under this reading (25) is true when John buys a boat each year and the boat he buys is increasingly bigger. This has been called the *internal reading* of the comparative (Carlson 1987). How to derive this reading is not straightforward. Intuitively the correlates should be the years, so *er* should take parasitic scope under *every*, as in (27)? But this only brings out a reading comparing each year to the same discourse antecedent, a particular year external to the domain of *every*. Not the interpretation we are after.

(27) [every$^x$ year [er$_{d',y}$ $\lambda d \lambda x.$[$x$ John buys a $d$-big boat]]]

This chapter aims to show that this difficulty is only superficial; it will disappear once we upgrade our formalization in a specialized dynamic framework. The upshot is to re-conceptualize the correlates of comparison, not as alternative variables, but as values of the same variable in alternative information states. Then we will see that a fully unified comparative meaning is possible, and it even eliminates some syntactic assumptions we were forced to make in the earlier chapters.

We begin by sketching what a possible analysis of the internal reading should look like, in section 5.2. Section 5.3 formalizes the account, which is couched in an upgraded dynamic framework. From there, we'll see that the required analysis of comparatives has the same conceptual core as our proposal developed through previous chapters, namely that a comparative compares a pair correlates on a given measurement relation. Section 5.4 then proposes a lexical entry of the comparative marker that unifies our account for the internal reading in this chapter and the analyses of comparatives' other uses in previous chapters. Section 5.5 compares my proposal to the two most relevant existing theories; the gist is that the correlate-comparison analysis has advantages in unifying the internal and the external reading as well as in dealing with the internal readings licensed by a distant distributive operator.. Section 5.6 concludes.

## 5.2 Preview of the account of the internal reading

### 5.2.1 Previous theories

The internal reading was first discovered on identity comparatives *same/different* (Carlson 1987), and was revealed on scalar comparatives like *bigger* later (Beck 2000). The compositional challenge this reading imposes is well-known (cf. Keenan 1992, Barker 2007). A line of fruitful investigations in recent years notwithstanding, none of the existing theories – which still overwhelmingly focus on *same/different* – can directly extend to the internal reading of scalar comparatives.

The first kind of existing theories let lexicalized universals distribute over every pair of distinct entities in its domain (Brasoveanu 2011, Bumford and Barker 2013), For instance, the meaning of *every boy recited a poem* can be paraphrased as in (28): every pair of distinct boys both read a poem. The meaning of a comparative relates and compares the two entities in each pair. The internal reading thus derived is truth-conditionally equivalent to (29).

(28) $\forall x, x' \in \textsf{boy}, x \neq x', \exists y, y' \in \textsf{poem} : \langle x, y \rangle, \langle x', y' \rangle \in \textsf{recited}$

(29) *Every boy recited a different poem* $\rightsquigarrow$

$\forall x, x' \in \textsf{boy}, x \neq x', \exists y, y' \in \textsf{poem} : \langle x, y \rangle, \langle x', y' \rangle \in \textsf{recited} \wedge y \neq y'$

The second approach analyzes lexicalized universal quantification as iterated dynamic conjunctions (Bumford 2015). The derived meaning of *every boy recited a different poem* can be paraphrased as (30); this becomes the internal reading when the standard in each comparison is provided by the immediately preceding conjunct:

(30) *Every boy recited a different poem* $\rightsquigarrow$

*John recited a different poem from some previously mentioned poems* AND

*Nick recited a different poem from some previously mentioned poems* AND

*Fred recited a different poem from some previously mentioned poems* AND ...

In the last kind of analysis, comparatives like *same* and *different* restrict the output of a (skolemized) choice function (Barker 2007, Lahm 2016)[1]. The results are listed below (details greatly simplified): the internal *different* restricts the poem read by each boy to be a poem that could be any but one recited by the other boys.

(31) *Every boy recited a different poem* $\rightsquigarrow$

$\forall x \in \textsf{boy} : \exists y : \ \textsf{poem}\, y \wedge \textsf{recited}(y, x) \wedge \neg\exists z \in \textsf{boy} : z \neq x \wedge \textsf{recited}(y, z)$

Lahm (2016)

The truth conditions of the internal reading of a scalar comparative, e.g. (25), is different from these meanings in two respects.

[1] Choice functions are functions from a set to an element of the set. However, for technical reasons, the function in both Barker (2007) and Lahm (2016) are defined to be a function from a set to a singleton set.

The first is that the internal reading of a scalar comparative is interpreted relative to a given ordering among years. In (32), the ordering is inferred from everyday knowledge: typically the jobs one person takes are also ordered in time. In fact, it seems impossible to get the internal reading of a scalar comparative when no such ordering can be inferred from the context. For instance, it seems very hard to get an internal reading from (33) in an out-of-blue context, because a set of boys usually does not come with an ordering. In contrast, an ordering never seems to play a role in the internal reading of *same* or *different*.

(32) Each job makes me more frightening to others and more passionate.

Brasoveanu (2011): ex. (204)

(33) Every boy recited a longer poem.

The second difference is that, while in all of these existing theories every entity in the distributive domain is a comparison target, this clearly cannot be true in the internal reading of scalar comparatives. We can test this by constructing sentences where the domain of the universal quantification is fixed by an overt adverbial phrase, e.g. (34). This sentence does not entail that I was more stressed in my first year than in any later year in grad school. Neither does it entail that the first year is more stressful than any year outside of grad school. The judgment becomes even sharper in (35), which contains a predicate of personal taste *beautiful* (cf. Egan 2010, a.o.). Predicates of personal taste like *beautiful* give rise to what Ninan 2014 calls the *Acquaintance Inference*: in using these predicates, the speaker is committed to having a relevant firsthand perceptual experience (see also Pearson 2013, Kennedy and Willer 2016, Anand and Korotkova 2018). In other words, it is infelicitous to state someone is beautiful without seeing them. Therefore, in this sentence, comparing the first time of my seeing John to any times I don't see him is not even an option. Since it is also impossible to compare this time to the later times, it seems compelling to say that the first time is simply not a comparison target in the internal reading of (35).

(34) When I was in grad school, I was more stressed every year.

(35) John is more beautiful every time I see him

In view of these observations, I believe it is fair to say that there is not yet a comprehensive compositional semantic analysis of the internal reading that covers not only *same/different* but also scalar comparatives.

### 5.2.2 *The* interpretation of the internal reading

In spite of the apparent discrepancies discussed above, it *is* possible to paraphrase the *every*-license internal reading with *same/different* or the scalar comparatives uniformly.

Suppose that the lexicalized universal quantification is always interpreted relative to an ordering of evaluation on the distributive domain. And suppose, once that ordering is fixed, the quantification of *each/every* amounts to assimilating every entity that comes later in the evaluation to the previous ones, in terms of the nuclear scope property. In short, *Every boy recited a poem* is interpreted as the following set of *as*-statements:

(36) Boy 2 recited a poem as boy 1 did, boy 2 recited a poem as boy 1 & 2 did, ...

Piggybacking on this rendering of lexical universals (more on how this is done later), the *every*-licensed internal reading can be interpreted as a series of incrementally construed comparisons between every later entity in the domain and its predecessors. In prose, *Every boy recited a different poem* is interpreted as (37) and, completely analogously, *Every year John buys a bigger boat* as (38). The only difference between the two is the specific ordering relation imposed by the comparative.

(37) Boy 2 recited a poem different from boy 1, boy 3 recited a poem different from boy 1 and 2, ...

(38) Year 2 John bought a boat bigger than in year 1, year 3 John bought a boat bigger than in year 1 and 2, ...

We can imagine that ordering relativization is only observable with scalar comparatives because only then do the truth conditions hinge on the specific ordering we choose. For (38), if we change the ordering of the years, say, from the temporal precedence relation to its reverse, the truth value of this statement will change accordingly. On the other hand, the truth conditions of the (37) will invariantly be equivalent to requiring each boy to be different from the other boys, no matter how the boys are ordered.

I argue that the same contrast is present in (39) and (40). While every quantifier is interpreted relative to a certain domain, and so the truth of (39) might be dependent on whether the domain is the editorial board or not, evaluating (40) requires no identified domain because it is guaranteed to be true by the subset relation between $[\![$semanticist$]\!]$ and $[\![$linguist$]\!]$, for any given domain.

(39) If every linguist agrees, we will publish the paper.

(40) If every linguist agrees to publish this paper, then we know that every semanticist agrees to publish it.

With the paraphrases in (37) – (38), the first entity is never a comparison target. It only appears to be one with *same/different* because the ordering relation they impose is symmetric: if A is the same as/different from B, B is the same as/different from A as well. Because of this symmetry, the truth conditions in (37) are equivalent to those in previous theories, where the first boy is a comparison target.

In sum, we can come up with a unified interpretation of the internal reading licensed by *every*, i.e., a series of comparisons between each later entity in the distributive domain to all its predecessors. The seeming differences between scalar comparatives and identity comparatives can be reduced to a side effect of the (a)symmetry of the ordering relation the comparative imposes.

### 5.2.3 Implementation using pairs

With a little revision to the basic idea developed in Brasoveanu (2011) and Bumford and Barker (2013), we can compositionally implement the targeted reading I have just sketched.

The idea on the conceptual level is that lexicalized distributive quantification is similar to focus interpretation in that it also introduces a non-ordinary semantic value managed in an additional information channel. Just like the focus value is accessible to focus-sensitive operators, the non-ordinary semantic values introduced by a lexicalized universal like *each/every* will be accessible to comparatives. The technical execution is couched in a specialized dynamic framework where sentence meanings are relations between *pairs* of information states. The additional channel that only *every* and comparatives make crucial use of is the secondary info state, i.e., the second member of a pair.

More concretely, to compositionally derive the internal comparisons I have sketched above, I will borrow the proposal in Brasoveanu (2011) that a lexicalized universal quantification contains a distributive update that distributes over pairs of entities in its domain – but change the pairs it distributes over. While Brasoveanu pairs up every two distinct entities in the distributive domain, I will let *every* distribute over pairs that are incrementally built, following the given ordering. Take *every year John buys a boat* for example, given the temporal ordering on *every*'s domain, the incrementally built pairs it distributes over are $\langle \textsf{year 2, year 1} \rangle$, $\langle \textsf{year 3}, \{\textsf{year 2, year 1}\} \rangle$, etc., and the distributive update checks if each of these pairs satisfies the nuclear scope of quantification, i.e., being a year where John buys a boat. The result is as shown in Figure 5.1: after the nuclear scope update, each state in a pair stores John and the boat he bought in the year stored in that state.

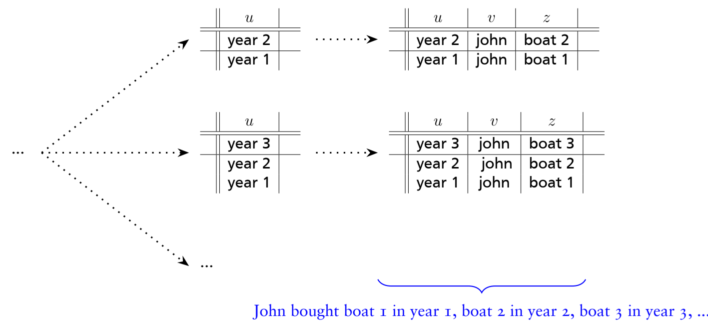



Figure 5.1: Sketch of pair-based distributive updates in *every year John buys a boat*

The comparative marker *er* introduces pairs of (maximal) degrees that satisfy its scope degree property, then imposes an ordering relation between them, which are now the values of the same degree dref in an info state pair. The internal reading arises when *er* is in the nuclear scope of *every*, above the variable it binds. For instance, with the LF in (41), *er* will introduce pairs of bigness degrees of the boats John bought in $u$; since the value of $u$ in each pair are passed on from *every*'s distributive update, these will be the bigness degrees of the boats John bought in year 1 and year 2, or the bigness degree of the boat he bought in year 3 and in year 1, 2, etc.. This is shown in Figure 5.2: as *every* passes along the incrementally-built pairs of years, the ordering relation imposed by *er* requires the boat stored in the primary state to be bigger than any of the boats stored in the secondary state (reminder: $\mathsf{d3} > \{\mathsf{d2, d1}\}$ iff $\mathsf{d3} > \mathsf{d2}$ and $\mathsf{d3} > \mathsf{d1}$); this is exactly the incremental comparisons we want for the internal reading.

(41) $[\,\text{every}^u \text{ year } \lambda u\,[\,\text{er } \lambda n[\,\text{a}^z\ n\text{-big boat } \lambda z[\,u \text{ John}^v \text{ buys}\,]\,]\,]\,]$

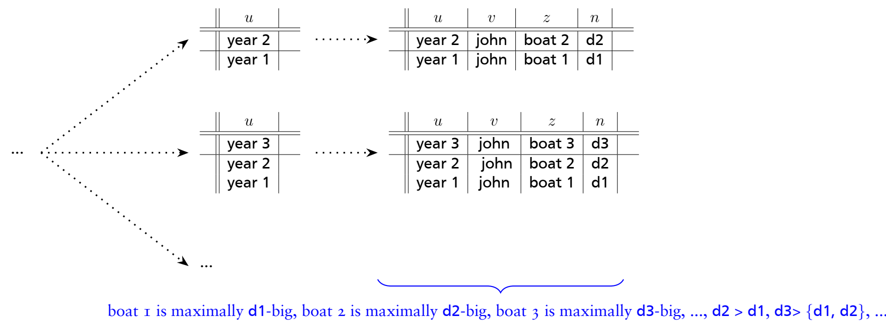



Figure 5.2: Sketch of the internal reading in *every year John buys a bigger boat*

## 5.3 Formal account of the internal reading

### 5.3.1 Formal background

Pluralities I will adopt a framework of pluralities that works a little easier with the dynamic system I will choose. Mostly, this means to represent a plural individual as a set, as opposed to mereological fusions (cf. Hoeksema 1987, Gillon 1987, Schwarzschild 1996, Winter 2002).

The interpretation function maps predicates and relations to $n$-tuples of plural individuals. Predicates and relations are cumulatively closed. That is, for any two entities $a, b$ and any predicate $P$, if $P(\{a\})$ and $P(\{b\})$ are true, so is $P(\{a, b\})$. Similarly for any $n$-ary relations $P'$: if $P'(\{x_0\}, ..., \{x_{n-1}\})$ and $P'(\{y_0\}, ..., \{y_{n-1}\})$ are both true, then $P'(\{x_0, y_0\}, ..., \{x_{n-1}, y_{n-1}\})$ is also true. Many lexical relations, like boys and met, are only defined for singleton sets unless pluralized under cumulation. I will skip the set notation when a predicate/relation is applied to singleton sets, (i.e., $P\{x\}$ and $Px$ will be used interchangeably), hopefully this won't cause any confusions.

Crucially, these include the ordering relation $>$. Since scales are only defined on singular degrees ($S = \langle \mathcal{D}_{\mathsf{d}}, > \rangle$), $X > Y$ between two plural degrees is undefined. But it can still be interpreted cumulatively: $\{x\} > \{y, z\}$ is true if $x > y$ and $x > z$;

$\{x, n\} > \{y, z\}$ is true if $x > y$ and $n > z$.

The framework for degree pluralities is basically the one proposed in Dotlačil and Nouwen (2016). The only difference is whereas Dotlačil and Nouwen implements pluralization using mereological sums, as in the Linkian tradition, I implement them using set formation. Again, this change is purely driven by technical reasons: thinking of pluralities as sets works a little better with the plural dynamic framework. THE BASELINE PLURAL DYNAMIC SYSTEM The baseline dynamic system is essentially that of Plural Compositional Discourse Representation Theory (PCDRT)[2] (Brasoveanu 2007, Brasoveanu 2008, I take some liberty in presentations throughout this paper[3]). On top of the basic static types ($\mathsf{t}$ for truth values, $\mathsf{e}$ for individuals, $\mathsf{d}$ for degrees), we add one more basic type, $\mathcal{V}$, as the type of variables. With this, we can construct (partial) assignment functions as functions from variables to (any type of) objects, which have the type $\mathsf{g} ::= \mathcal{V} \to \mathsf{a}$. A plural information state is a set of assignment functions, type $\mathsf{G} ::= \mathsf{g} \to \mathsf{t}$. $\mathcal{T} ::= \mathsf{G} \to \mathsf{G} \to \mathsf{t}$ is thus the type of a CCP. Sentence meanings are context change potentials (CCP), which are (normally) relations between plural info states.

In addition, a dummy individual $\star$ is incorporated into the range of our assignment functions. $\star$ is a universal falsifier for any lexical relations; that is, any lexical relation with $\star$ as one of its arguments is false. It is useful in a number of ways, e.g., we can model information growth as a process of replacing the dummy individuals with real referents. What's relevant to us is it will also be needed in the definition of *every*.

A plural discourse referent (dref) is the set of all the objects stored at the same variable position in a state, excluding the dummy individual (42). Lexical relations are interpreted distributively within a plural info state (43). Existential quantification

[2] It is possible to formalize the analysis using Berg's Dynamic Plural Logic as well, I'm only choosing PCDRT here because it makes the composition a little easier.

[3] The main difference from Brasoveanu's original formulation of PCDRT is that he makes the type of assignments, as opposed to variables, to be primitive.

| G | $u$ | $v$ |
|---|---|---|
| $g_0$ | a | x |
| $g_1$ | b | y |
| $g_2$ | c | y $\oplus$ z |
| $g_3$ | a $\oplus$ b | z |

(a) A plural info state

$G[\exists u']$

| $J$ | $u$ | $v$ | $u'$ |
|---|---|---|---|
| $J_0$ | a | x | e |
| $J_1$ | b | y | e |
| $J_2$ | c | y $\oplus$ z | e $\oplus$ f |
| $J_3$ | a $\oplus$ b | f | f |

...

(b) Introducing a new plural dref

Figure 5.3: Plural Compositional Discourse Representation Theory

in non-plural systems like DPL (Groenendijk and Stokhof 1991) or CDRT (Muskens 1996) extends the input assignment function with nondeterministic assignments of a certain variable (44). Existential quantification with plural info states is defined as the cumulative-quantification style generalization of this dref introduction (45).

(42) $S_u$:= $\bigsqcup \{s_u \mid s \in S \wedge s_u \neq \star\}$ $\quad$ $\mathsf{a} \to \mathsf{t}$

(43) [walks] := $\lambda u.$**walks** $u$ where **walks** $u$ := $\lambda S.\{S \mid \forall s \in S : s_u \in \mathsf{walks}\}$ $\quad$ $\mathcal{T}$

(44) $s[\exists u]$ := $\{s^{u \to x} \mid x \in D\}$

(45) $S[\exists u]$ := $\{I \mid \forall s \in S : \exists i \in I : i \in \{s^{u \to x} \mid x \in D\}, \forall i' \in I : \exists s' \in S : i \in \{s'^{u \to x} \mid x \in D\}\}$

For instance, $G$ in Figure 5.3a is a plural info state. In this state, $G_u$ refers to the plural individual stored in the $u$ column $\{\mathsf{a}, \mathsf{b}, \mathsf{c}, \mathsf{a} \oplus \mathsf{b}\}$. **met**$(u, v)$ denotes a lexical relation test, $G$ can pass this test (i.e., $G[\mathbf{met}(u, v)] \neq \emptyset$) so long as in *all* rows of $G$ the relation met holds between the assignment of $u$ and the assignment of $v$, i.e., $\langle \mathsf{a}, \mathsf{x}\rangle, \langle \mathsf{b}, \mathsf{y}\rangle, \langle \mathsf{c}, \mathsf{y} \oplus \mathsf{z}\rangle, \langle \mathsf{a} \oplus \mathsf{b}, \mathsf{z}\rangle \in \mathsf{met}$. Introducing a plural dref $u'$ proceeds in the way depicted in Figure 5.3b: all the assignments in the output state has a predecessor in the input; in any output state, and all the assignments in the input state has a successor that has a value associated with $u'$.

Finally, a feature of plural info states that we will take advantage of to define distributivity is the possibility to define substates, i.e. subsets of an info state in which the assignment of $u$ is a particular value. This is given in (46). For $G$ in Figure (5.3a), $G|_{u=\{\mathsf{a}\}}$ is the subset where the value of $u$ is a member of $\{\mathsf{a}\}$, i.e., the first row $\{g_0\}$; $G|_{u=\{\mathsf{a}, \mathsf{c}\}}$ is $\{g_0, g_2\}$.

(46) $S|_{u=X} := \{s \in S \mid s_u \in X\}$ $\quad\mathsf{G}$

### 5.3.2 Upgrading to pairs

Let's add a product type $\mathsf{G} \times \mathsf{G}$ as the type of pairs of (plural) info states into the system. Sentence meanings (CCPs) are now relations between pairs of info states, type $\mathbb{T} ::= \mathsf{G} \times \mathsf{G} \to \mathsf{G} \times \mathsf{G} \to \mathsf{t}$. The definition of dynamic conjunction is also upgraded to apply to pairs:

(47) $; := \lambda L \lambda R \lambda \langle S, S' \rangle . \{\langle I, I' \rangle \in R \langle K, K' \rangle \mid \langle K, K' \rangle \in L \langle S, S' \rangle\}$ $\quad\mathbb{T} \to \mathbb{T} \to \mathbb{T}$

The secondary state of a pair is mostly a mirror image of the primary state (cf. Bumford and Barker 2013). Ordinary predicates are relations from variables to tests on the input context, and now their tests are imposed on the two states of a pair simultaneously; e.g., **recited** $(u, v)$ tests if $u$ and $v$ in both the primary and the secondary states satisfy the recited relation (48). (Dynamic) names are also a direct pair-generalization of their PCDRT meaning, as shown in (49): **john**$^u$ introduces john to the $u$ position in both states of a pair (49).

(48) $\textbf{recited} := \lambda u \lambda v \lambda \langle S, S' \rangle . \left\{ \langle S, S' \rangle \mid \begin{array}{c} \forall s \in S : (s_u, s_v) \in \mathsf{recited} \\ \forall s \in S' : (s_u, s_v) \in \mathsf{recited} \end{array} \right\}$ $\quad\mathcal{V} \to \mathcal{V} \to \mathbb{T}$

(49) $\textbf{john}^u := \lambda P . {}^{\top}u \to \mathsf{j}, {}^{\perp}u \to \mathsf{j}; Pu$ $\quad(\mathcal{V} \to \mathbb{T}) \to \mathbb{T}$

$$^{\top}u \to \mathsf{j}, {}^{\perp}u \to \mathsf{j} := \lambda \langle S, S' \rangle . \left\{ \left\langle S^{u \to \mathsf{john}}, S'^{u \to \mathsf{john}} \right\rangle \right\}$$

Indefinites introduce indeterminacy into the input context. With pairs, they introduce a dref that is indeterminate within a pair, i.e. a dref associated with two possibly different values.

(50) $\textsf{a}^u := \lambda P \lambda Q.\exists u; Pu; Qu$ $\qquad (\mathcal{V} \to \mathbb{T}) \to (\mathcal{V} \to \mathbb{T}) \to \mathbb{T}$

$$\exists u := \lambda \langle S, S' \rangle . \{\langle I, I' \rangle \mid I \in S[\exists u], I' \in S'[\exists u]\}$$

We can also define a pair-based maximization operator $\mathbb{max}^u$ (51), which maximizes the $u$-value distributively in a pair, i.e. it lets the context update with its scope CCP and keeps only the info state pairs where neither the $u$-value of the primary state or the $u$-value of the secondary state is less than other states in the output.

(51) $$\mathbb{max}^u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \in \langle S, S' \rangle [\exists u; M] \mid \begin{array}{l} \neg\exists \langle K, K' \rangle \in \langle S, S' \rangle [\exists u; M] : \\ K_u > I_u \text{ or } K'_u > I'_u \end{array} \right\}$$

### 5.3.3 Lexicalized distributivity with pairs

The meaning of a lexicalized universal is re-defined as (52):

(52) $\textsf{every}^u := \lambda P \lambda Q.\exists u; \mathbb{max}^u(Pu); \mathbb{D}_u(Qu)$

$$\mathbb{D}_u := \lambda M \lambda \langle S, S' \rangle \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \exists \overrightarrow{x} \text{ on } S_u : \forall n : 0 < n < |S_u| \to \\ \left\langle S|_{u=\{x_n\}}, S|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle [M] \left\langle I|_{u=\{x_n\}}, I|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle \end{array} \right\}$$

Now suppose the nuclear scope property $P$ is **year**. The PCDRT-style universal quantification will first store the maximal set of years as the restrictor set update. The restrictor set update of $\textsf{every}^u$ defined in (52) is merely the pair-generalization of this update: it will store the maximal set of years in both the primary state $u$-position and the secondary state $u$-position.

The crucial difference between PCDRT-style universal quantification and the pair-based universal quantification is in the nuclear scope update. $\textsf{every}^u$ defined in (52) directly distributes the nuclear scope property over the restrictor set using a distinct distributivity operator $\mathbb{D}_u$.

Let's unpack the meaning of $\mathbb{D}_u$. It associates an input and output pair of plural states with the same bookkeeping on the value of $u$ ($S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}$), so the $u$-column in the primary state is unchanged from the input to the output. The clause $I = I'$ is there to ensure that the two states in the output are identical to each other – this will become useful in section ??. The rest is about how to distribute over the $u$-column of the input primary state using pairs, following a contextually given ordering $\overrightarrow{x}$: $\mathbb{D}$ checks that each pair of the input-substate containing the $n+1$th entity ($S|_{u=\{x_n\}}$) and the input-substate containing all the prior $u$-values ($S|_{u=\{x_0,\ldots x_{n-1}\}}$) passes the nuclear scope update and arrives at the corresponding pair of substates in the output. In other words, with the given ordering, every pair of a later entity and its predecessors is required to have the nuclear scope property.

Using the LF in (53), we derive the meaning of *every year John buys a boat* in (54). These updates are visualized in Figure 5.4. After the restrictor set update, we have a pair of states, each of them stores the maximal set of relevant years in the $u$ position (i.e., $\langle I, I'\rangle$ in Figure 5.4). $\mathbb{D}$ checks that the nuclear scope holds for each pair of a later year and the years before. If they do, we get a set of output states like $\langle J, J'\rangle$: two identical copies of a plural state, which stores the years and the quantificational dependencies between years and the boat bought in those years.

(53) [ every$^u$ year $\lambda u$ [a$^z$ boat $\lambda z$ [ John$^v$ buys $z$ ] ] ]

(54) $\mathbb{max}^u(\textbf{year}\, u); \mathbb{D}_u(\exists z; \textbf{boat}\ z; v \to \textbf{j}; \textbf{buys}(z, v, u))$

### 5.3.4 Internal comparisons on pairs

Below is a simple definition of *er* that exploits pair-based distributivity:

(55) $\textbf{er}^n := \lambda f.\mathbb{max}^n(fn); >_n$ where $>_n := \lambda \langle S, S'\rangle . \{\langle S, S'\rangle \mid S_n > S'_n\}$

$(\mathcal{V}_\mathsf{d} \to \mathbb{T}) \to \mathbb{T}$

This $\textbf{er}^n$ compares alternative values of the same degree dref in a pair. In order

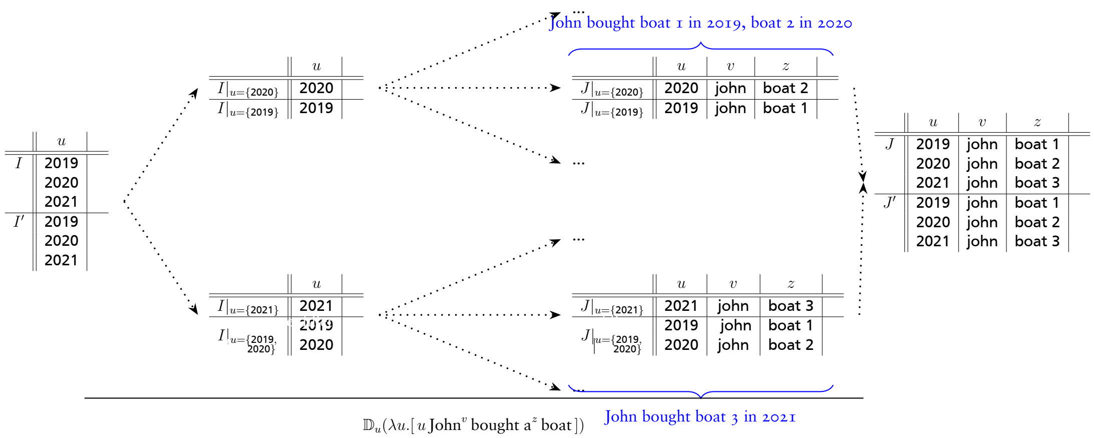



Figure 5.4: Pair-based distributivity

for the comparison to be possible, the variable $u$ in the scope of *er* must be a dref that the degree dref is dependent on and gets assigned (possibly) different values in a pair. This variable can easily be the variable bound by *every* when *er* is in its nuclear scope, in which case we derive a comparison between the pair-values assigned by $\mathbb{D}$.

Using the LF in (56), the meaning of *every year John buys a bigger boat* comes out as (57).

(56) $[\,\text{every}^u\text{ year }\lambda u\,[\,\text{er}^n\ \lambda n\,[\text{a}^z\ n\text{-big boat }\lambda z\,[\,\text{John}^v\text{ buys }z\,]\,]\,]\,]$

(57) $\mathbb{max}^u(\textbf{year}\ u);\mathbb{D}_u(\mathbb{max}^n((\exists z;\textbf{big}(n,z);\textbf{boat}\ z;v\to\textbf{j};\textbf{buys}(z,v,u)));>_n)$

Comparing (57) to (54), we can see the comparative contributes to the scope of $\mathbb{D}_u$ two more context updates:

(i) Introducing the maximal bigness degrees of the boat(s) that John buys in the primary and the secondary state, respectively[4];

(ii) Testing if the degree in the primary state is larger than the secondary state.

Figure 5.5 illustrates more vividly what the modified pair-distributivity looks like. Let the boats John bought in 2019 be maximally $\mathsf{d}'$-big, the boats bought in 2020 be

[4]Since the degree maximization scopes over the existential introduction of the boats, we get the maximal degree of the biggest boats.

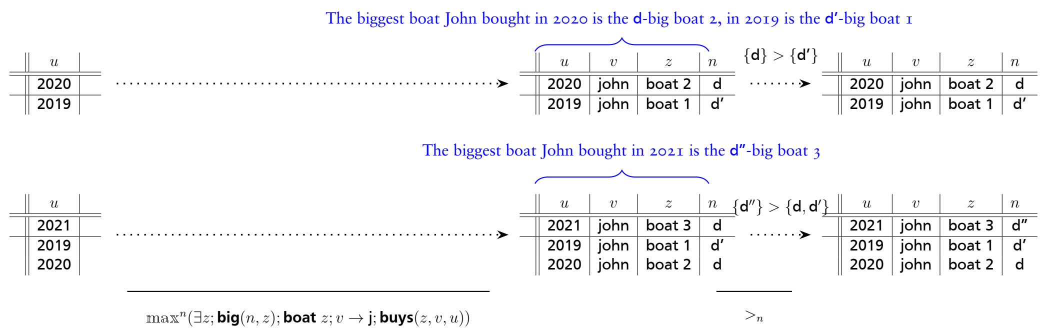



Figure 5.5: Comparisons in the internal reading

d-big, and the boats in 2021 d″-big. The distributive updates return true if $\{\mathsf{d}\} > \{\mathsf{d'}\}$ and $\{\mathsf{d''}\} > \{\mathsf{d}, \mathsf{d'}\}$. I assume, following Dotlačil and Nouwen's (2016) framework on degree pluralities, that both are only defined under a cumulative interpretation, so they are equivalent to $\mathsf{d} > \mathsf{d'}$ and $\mathsf{d''} > \mathsf{d}$, $\mathsf{d''} > \mathsf{d'}$, respectively. Eventually, the sentence is true if in 2021 John bought a boat bigger than the biggest boats he bought in 2020 *and* in 2019, in 2020 he bought a boat bigger than the biggest boat he bought in 2019. This is exactly the internal reading we are after.

### 5.3.5 Varieties of internal readings

Brasoveanu (2011) shows that his system can generate internal readings licensed by things other than lexicalized universals, which are attested for *same* and *different*. I'll show that we can also generate these readings – essentially the same analyses can be re-phrased in the current system.

I will give *same/different* the same comparative analysis in chapter 2, de-composing them into a predicate of identity and a scope-taking comparative marker:

(58) IDENT := $\lambda z \lambda v . v = z$

(59) different $\rightsquigarrow$ DIFF - IDENT

$$\text{DIFF}^z_u := \lambda f . \mathtt{max}^z(f\,z); \neq_z \;\; \text{where} \;\; \neq_z := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid S_u \not\subseteq S'_u\}$$

(60) different $\rightsquigarrow$ SAME - IDENT

$$\textsc{same}^z_u := \lambda f.\mathbb{max}^z(fz); =_z \ \text{ where } \ =_z := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid S_u = S'_u\}$$

The *every*-licensed internal readings are derived in the same way as scalar comparatives, when the comparative marker co-indexed with the universal quantifier. With the dynamic definition of the definite determiners given in (61), readers are welcomed to check that the interpretations we thus derived in (62) and (63) say that as $\mathbb{D}$ looks through the domain of *every*, the next boy it encounters always recited a poem that is different or the same as all the previous boys.

(61) $[\text{the}^v] := \lambda P \lambda Q.\mathbb{1}_v(\exists v; Pv; Qv)$ $\quad (\mathcal{V} \to \mathbb{T}) \to (\mathcal{V} \to \mathbb{T}) \to \mathbb{T}$

$$\mathbb{1}_v := \lambda M \lambda \langle S, S' \rangle . \left\{ \begin{array}{l} I \in \langle S, S' \rangle [M] \text{ iff } |\{K_v \mid K \in \langle I, I' \rangle \in \langle S, S' \rangle [M]\}| = 1 \\ \text{undefined otherwise} \end{array} \right\}$$

(62) $[\text{Every}^u \text{ boy } \lambda u[\textsc{diff}^z_u\, \lambda z\, [\text{a}^v\ z\text{-}\textsc{ident} \text{ poem } \lambda v[u \text{ recited } v]]] \rightsquigarrow$
$\mathbb{max}^u(\textbf{boy}\, u); \mathbb{D}_u(\mathbb{max}^z(\exists v; v = z; \textbf{poem}\ v; \textbf{recited}(v, u)); \neq_z)$

(63) $[\text{Every}^u \text{ boy } \lambda u[\textsc{same}^z_u\, \lambda z\, [\text{the}^v\ z\text{-}\textsc{ident} \text{ poem } \lambda v[u \text{ recited } v]]] \rightsquigarrow$
$\mathbb{max}^u(\textbf{boy}\, u); \mathbb{D}_u(\mathbb{max}^z(\mathbb{1}_v(\exists v; v = z; \textbf{poem}\ v; \textbf{recited}(v, u))); =_z)$

*same* and *different* also receive internal readings licensed by expressions other than lexicalized universals. A plural noun phrase is a possible licensor for *same* and plural *different* (i.e., *different* contained in a plural noun phrase), in sentences like *three boys recited different poems/the same poem*. I take the spirit of Brasoveanu's analysis of this reading to be essentially right – they are licensed by a covert $\mathbb{D}$ (or Brasoveanu's **dist**) distributing over the set denoted by the noun phrase containing *same/different*. The LFs deriving these readings are given in (65) and (66), the determiner takes scope and the comparative marker takes scope inside the noun phrase ($\text{EC}^v$ is the silent existential determiner I assume for bare NPs), under the covert $\mathbb{D}$, with which it is co-indexed:

(64) $[\text{three}^v] := \lambda P \lambda Q. \exists v; \mathbf{3}_v; Pv; Qv$ $\qquad (\mathcal{V} \to \mathbb{T}) \to (\mathcal{V} \to \mathbb{T}) \to \mathbb{T}$

$$\mathbf{3}_v := \lambda M \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid |S_v| = 3, |S'_v| = 3\}$$

(65) $[\text{Three}^u \text{ boys } \lambda u[\text{EC}^v \lambda v[\mathbb{D}_v[\textsc{diff}^z_v \lambda z[v[z\text{-}\textsc{ident} \text{ poem }]]]\lambda v[u \text{ recited } v]]]$

$\rightsquigarrow \exists u; \mathbf{3}_u; \textsf{\textbf{boys}}\, u; \exists v; \mathbb{D}_v(\mathbb{max}^z(v = z; \textsf{\textbf{poem}}\, v); \neq_z); \textsf{\textbf{recited}}\,(v, u)$

(66) $[\text{Three}^u \text{ boys } \lambda u[\text{the}^v \lambda v[\mathbb{D}_v[\textsc{same}^z_v \lambda z[v[z\text{-}\textsc{ident} \text{ poem }]]]\lambda v[u \text{ recited } v]]]$

$\rightsquigarrow \exists u; \mathbf{3}_u; \textsf{\textbf{boys}}\, u; \mathbb{1}_v(\exists v; \mathbb{D}_v(\mathbb{max}^z(v = z; \textsf{\textbf{poem}}\, v); =_z); \textsf{\textbf{recited}}\,(v, u))$

The parts of the meanings in (65) - (66) relevant to the internal comparisons in blue. What we have derived here are comparisons inside the values assigned by the noun phrases, i.e., (65) says the poems are non-identical ones and (66) says they are the same one. What gives rise to the flavor of an internal reading is the default cumulative interpretation of plural predication, i.e., $\textsf{recited}(\{\textsf{poem 1, poem 2, poem 3, poem 4}\}, \{\textsf{boy 1, boy 2, boy 3}\})$ is true in a scenario where the poem recited by each boy is different from those recited by others, as long as the total of these three boys recited the total of those four poems. Similarly for *same* – that all the boys stand in the reciting relation with one poem is equivalent to saying that the poem recited by each of them is identical to the poem recited by others. We can also explain why this kind of internal reading is not possible with the singular *different*, it's because it isn't possible to satisfy the ordering relation of *different* in the distribution of a singleton set, i.e. nothing can be different from itself.

Beck (2000) notes that the singular and the plural *different* are two morphologically distinct items in German. This is consistent with this account: it is possible that an optional lexical incorporation of the covert distributivity operator happens in some (but not all) languages. In other words, we can say that the German plural *different* (*verschieden*) is exactly like English *different* (or German *anders*) except that its comparative marker is $\textsc{diff'}^z_v$ :

(67) $\textsc{diff'}^z_v := \lambda f.\mathbb{D}_v(\mathbb{max}^z(fz)); \neq_z)$

The last kind of internal reading is one licensed by expressions like *both/all* and aspectual modifiers like *for*-adverbials. According to Brasoveanu (2011), these licensors can only license the internal reading of *same*:

(68) Both/all boys recited the same poem.

(69) John recited the same poem for five days.

Also following Brasoveanu's solution here, these internal readings in (68) - (69) can be explained if these licensors distribute over pairs of each entity in their domain and the entire set (70). For example, with *both* defined in (71) and the LF in (72), we derive a reading that says each of the two boys recited a poem that is the same as the poem recited by both of them.

(70) $$\mathbb{D}'_u := \lambda M \lambda \langle S, S' \rangle \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \forall x \in S_u : \left\langle S|_{u=\{x\}}, S \right\rangle [M] \left\langle I|_{u=\{x\}}, I \right\rangle \end{array} \right\}_{\mathbb{T} \to \mathbb{T}}$$

(71) $[\,\text{both}^u\,] := \lambda P \lambda Q.\exists u; \mathbf{2}_u; Pu; \mathbb{D}'_u(Qu)$ $\qquad (\mathcal{V} \to \mathbb{T}) \to (\mathcal{V} \to \mathbb{T}) \to \mathbb{T}$

(72) $[\,\text{Both}^u \text{ boys } \lambda u[\,\textsc{same}^z\ \lambda z\,[\,\text{the}^v\ z\text{-}\textsc{ident}\text{ poem } \lambda v[\,u \text{ recited } v\,]\,]\,] \rightsquigarrow$

$\exists u; \mathbf{2}_u; \textbf{boys}\ u; \mathbb{D}'_u(\mathbb{max}^z(\mathbf{1}_v(\exists v; v = z; \textbf{poem}\ v; \textbf{recited}(v, u))); =_z)$

The reason that this reading is only possible with *same* is because whole-set distributivity (as defined in (70)) is impossible to combine with the comparison of *different* or scalar comparatives. It is impossible that each of the two boys recited a poem that is disjoint from the poems recited by both, or is longer/more interesting than the poems recited by both boys.

**Interim conclusion.** In this section, I have shown that we can give fully compositional treatments to the variety of internal readings of comparatives, using distributivity operators and comparative markers that operate on pairs of information states.

The main advantage is that we extend the empirical coverage to scalar comparatives, and for (I believe) the first time explain the subtle differences between scalar comparatives and identity comparatives.

## 5.4 A unified comparative meaning

### 5.4.1 Comparative anaphora with pairs

We now have two lexical entries for *er*, repeated below: (74) for the *every*-licensed internal reading, and (73) from chapter 2-4 that takes care of its uses outside of the internal reading. An obvious question is whether we can have a unified meaning of *er* that encompasses both uses.

(73) $\textsf{er}^{v,m,n}_{n',u'} := \lambda f \lambda u.\exists v; \textsf{max}^m(fmv); \textsf{max}^n(fnu); n > m; \underline{{}^{v=u',m=n'}}$

$$(\mathcal{V}_{\mathsf{d}} \to \mathsf{a} \to \mathcal{T}) \to \mathcal{T}$$

(74) $\textsf{er}^n := \lambda f.\mathrm{max}^n(fn); >_n \qquad (\mathcal{V}_{\mathsf{d}} \to \mathbb{T}) \to \mathbb{T}$

(74) is similar to (73) in that a comparison between alternative contexts/info states is but a different formulation of a comparison between two correlates on a given measurement function – as we have just observed, we can compare two degree values using (74) because they are maximal degrees relative to different years. The real difference between the two meanings lies in the two components in (73) that are missing in (74). The first is introducing an indefinite correlate, $\exists u$ in (73).The second is the anaphoric postsupposition, $\underline{{}^{v=u',m=n'}}$ in (73).

We can have a unified comparative meaning simply by adding these two components into the pair-based entry (74). The final proposal for the unified *er* is (75):

(75) $\textsf{er}^{\perp u,n}_{u',n'} := \lambda f.\exists^{\perp} u; \mathrm{max}^n(fn); >_n; \underline{{}^{\perp u=u',\perp n=n'}} \qquad (\mathcal{V}_{\mathsf{d}} \to \mathbb{T}) \to \mathbb{T}$

$$\langle S, S' \rangle\, [\exists^{\perp} u] := \{\langle I, I' \rangle \mid I = S, I' \in S[\exists u] \in \mathcal{D}\}$$

$$^{\perp}u = u',^{\perp} n = n' := \lambda \langle S, S' \rangle\, . \{\langle S, S' \rangle \mid S'_u = S_{u'}, S'_n = S_{n'}\}$$

(75) is but a reformulation of (73) using pairs, and therefore it inherits all the merits of this analysis on the externally anaphoric comparative that I have argued for in previous chapters.

Let's first see how it derives the externally anaphoric reading we have considered in Chapter 2. For (76), the target correlate of comparison in the given context is obviously the subject, *John's boat*, so we let the subject take scope and the co-indexed *er* take scope under it (77); this gives *er* a chance to re-assign the value of the variable bound by the subject. The LF in (77) derives the meaning in (78), and after the post-supposition is discharged, (79). These updates are illustrated in Figure 5.6. Up untill after the subject assigns $u$ to John's boat ($u \rightarrow \textsf{j's boat}$), we have in the context pairs of info states that are identical to each other. Next, $\textbf{er}^{\perp u,n}_{u',n'}$ conducts a destructive update: it re-writes the value of $u$ in the secondary state to some indefinite object ($\exists^{\perp}u$), so we have in the output a set of pairs assigning the secondary value of $u$ to possibly different things, $\textsf{a}$, $\textsf{b}$, etc.. Then we introduce the maximal bigness degrees of $u$ to the $n$ position; now because both the normal lexical relations and the maximization $\mathbb{max}$ are checked distributively in a pair, the output of this update stores the maximal bigness degrees of John's boat – the primary $u$-value – in the primary $n$ position, and the maximal bigness degrees of the secondary $u$-value – the indefinite object introduced by $\textbf{er}^{\perp u,n}_{u',n'}$ – in the secondary $n$-position. After this we check if the primary $n$-value exceeds the secondary $n$-value; pairs where the secondary $u$-assignment is a thing that John's boat isn't bigger than (e.g. $\textsf{b}$), are filtered out. Finally, the post-suppositional test is applied, and we have in the context only those pairs where the secondary $u$-value is identical to Nick's boat and the secondary $n$-value is identical to Nick's boat's maximal bigness degree. This makes it clear that the comparison is between John's boat and Nick's boat, true if John's boat is the bigger one between the two. Since the degree antecedent of the comparative is still presupposed to be the measurement of the standard correlate on the given dimension, as in chapter 2, we

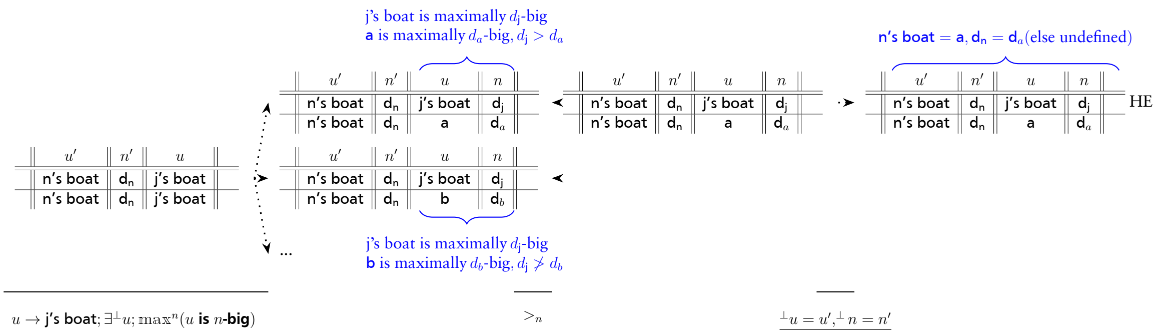



Figure 5.6: Comparative updates in the external reading, using pairs

can still explain the comparative's sensitivity to a larger context than the saliency of a degree.

(76) Nick's boat is small. John's boat is bigger.

(77) [John's boat $\lambda u$[ $\text{er}^{\perp u,n}_{u',n'}$ $\lambda n$ [ $u$ is $n$-big ] ] ]

(78) $u \to$ **j's boat**; $\exists^{\perp}u$; $\max^n(u$ **is** $n$**-big**$)$; $>_n$; $\underline{^{\perp}u{=}u', ^{\perp}n{=}n'}$

(79) $u \to$ **j's boat**; $\exists^{\perp}u$; $\max^n(u$ **is** $n$**-big**$)$; $>_n$; $\underline{^{\perp}u = u', ^{\perp}n = n'}$

Compared to the derivation in Chapter 2-3, the only difference is a structural one: though the scope-taking of *er* here is still parasitic on another scope-taking operator in the sentence, with which it is co-indexed, the pair-based $\mathbf{er}^{\perp u,n}_{u',n'}$ needs not take scope over the abstraction of its licensing operator. It can simply intervene between its licensing operator and the variable it binds to introduce and make comparison to the secondary alternative value of that variable. All the comparisons we can generate before can be replicated with $\mathbf{er}^{\perp u,n}_{u',n'}$, using a structure that no longer requires the licensing operator's scope-taking to precede the comparative marker's scope-taking[5]:

[5] As before, to deal with this kind of comparison over multiple correlates, we need to adjust the definition of *er* in (75) to the following: $[\text{er}^{\perp u_0,\ldots,\perp u_n,n}_{u'_0,\ldots,u'_n,n'}] := \lambda f.\exists^{\perp}u_0,\ldots{}^{\perp}u_n; \max^n(fn); >_n ; \underline{^{\perp}u_0{=}u'_0,\ldots,{}^{\perp}u_n{=}u'_n, {}^{\perp}n{=}n'}$.

(80) I thought Mary is quite tall. Today I finally met a taller woman.

$\rightsquigarrow [\text{a } \lambda u[\text{er}^{\perp u,n}_{u',n'} \lambda n [u[n\text{-tall woman}]]]]$

(81) John read five books. Mary read more (books).

$\rightsquigarrow [\text{Mary } \lambda u[\text{er}^{\perp u,n}_{u',n'} \lambda n [n\text{-many books } \lambda z[u \text{ read } z]]]]$

(82) John criticized five books. He PRAISED more (books).

$\rightsquigarrow [\text{PRAISED } \lambda u[\text{er}^{\perp u,n}_{u',n'} \lambda n [n\text{-many books } \lambda z[\text{He } u\ z]]]]$

(83) John was required to donate five books. He ended up donating more (books).

$\rightsquigarrow [\textsc{ind}_{@} \ \lambda w[\text{er}^{\perp w,n}_{w',n'} \lambda n [n\text{-many books } \lambda z[\text{He ended up donating}_w\ z]]]]$

(84) John criticized five books. Mary PRAISED more (books).

$\rightsquigarrow [\text{Mary } \lambda v[\text{PRAISED } \lambda u[\text{er}^{\perp u, \perp v,n}_{u',v',n'} \lambda n [n\text{-many books } \lambda z[v\, u\ z]]]]]$

Re-casting our analysis of explicit comparatives within the pair-based system is also straightforward, as shown in the complete derivation of *John is taller than Mary is* in Figure 5.7. The updates we get are visualized in 5.8.

We can also use the pair-based entry (75) to explain the cross-linguistic ambiguities in essentially the same way as in chapter 4. The externally anaphoric *more* acquires an additive reading with the help of an operator $\mathbf{ADD}_u$, re-defined in (85). An additive comparison can be turned into part of a continuative meaning by the operator **CONT**, re-defined in (86).

(85) $\mathbf{ADD}_u := \lambda M.{}^{\perp}u \rhd^{\top} u; M$ $\qquad \mathbb{T} \to \mathbb{T}$

$$^{\perp}u \rhd^{\top} u := \lambda \langle S, S' \rangle \,.\, \left\{ \left\langle S^{u \to u \oplus S'_u}, S'^{u \to \star} \right\rangle \mid \right\}$$

(86) $\mathbf{CONT} := \lambda P \lambda M \lambda Q.M; \underline{P(\lambda n.Q(n \leq_M u))}$

$$n \leq_M u := M; \underline{u \to n; M} \text{ where}$$

$$u \to n := \lambda \langle S, S' \rangle \,.\, \left\{ \left\langle S^{u \to S_u}, S'^{u \to S'_n} \right\rangle \right\}$$

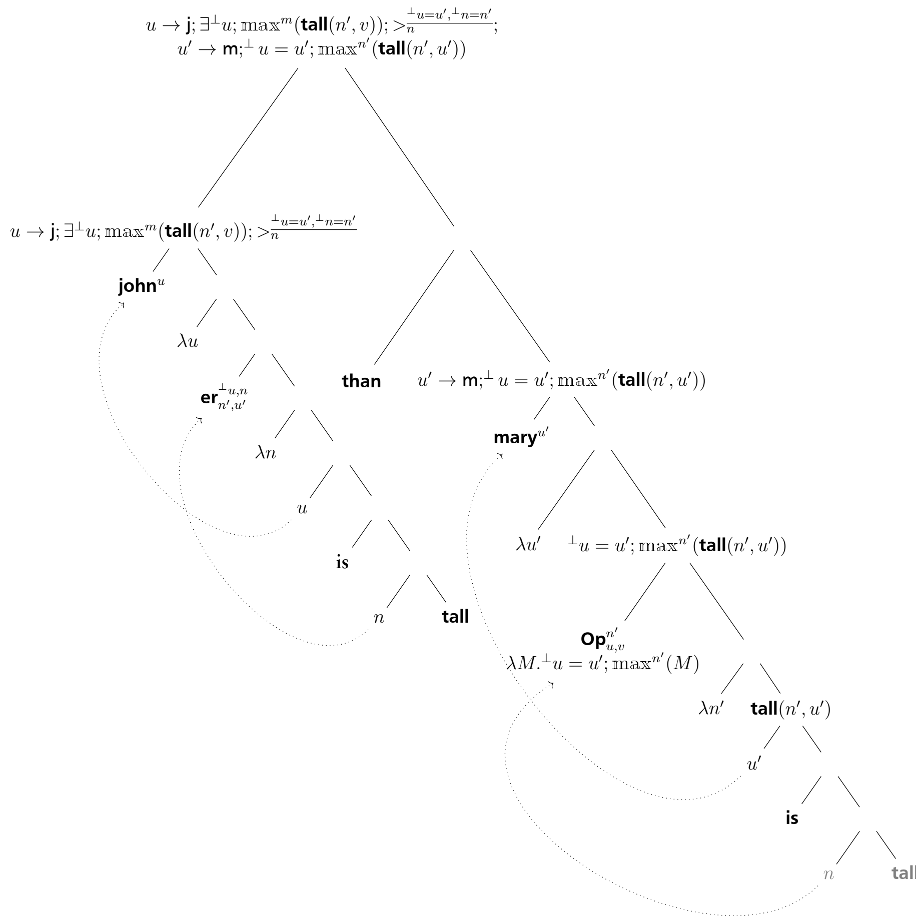


Figure 5.7: Composing an explicit comparative with pairs

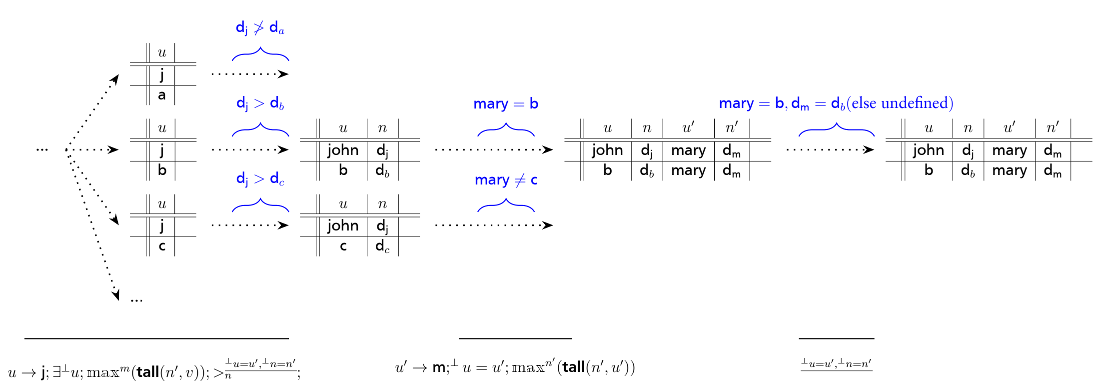


Figure 5.8: Updates of *John is taller than Mary is* with pairs

$$((\mathcal{V}_{\mathsf{d}} \to \mathbb{T}) \to \mathbb{T}) \to \mathbb{T} \to (\mathbb{T} \to \mathbb{T}) \to \mathbb{T}$$

There are small differences in how these operators do their jobs in a pair-based framework: whereas the $\textbf{ADD}_v$ in chapter 4 sums up (the value of) two variables, $\textbf{ADD}_u$ in (85) re-writes the value of a dref in the primary state to be the sum of it and the secondary value (while wiping off the value in the secondary state); whereas **CONT** in Chapter 4 projects the no-stronger alternatives of a variable $u$ regarding a function $f$, the **CONT** in (86) here projects the no-stronger alternatives of $u$ regarding a CCP $M$. Let me explain the definition of this projection, $n \leq_M u$ in (86), a bit more. We can consider the value of $n$ is a no-stronger alternative of the value of $u$ regarding a CCP $M$ iff in the context updated by $M$, it is presupposed to be true that if we re-assign the value of $u$ to be the value of $n$, $M$ is still true. For instance, suppose the value of $u$ is John and the CCP $M$ is $u$ is tall, then $n \leq_{u \textsf{ is tall}} u$ just in case $M$ is true – John is tall, and that in the context where John is tall, it is presupposed to be true that we can re-assign $u$ to the value of $n$, and $u$ is tall is still true – which just means John is tall entails the value of $n$ is tall, i.e., the value of $n$ is at least as tall as John.

The derivation of the additive reading of *John bought more apples* and the temporal continuative reading of *it is still raining* are given in Figure 5.9 and Figure 5.10. We can account for the cross-linguistic ambiguities by giving the CAC operators the same de-compositional analysis as in Chapter 4. The only difference here, again, is a structural one: in chapter 4 er-CONT is base-generated in a position above the licensing operator's abstraction, now this is not required. The theory no longer requires the merge of er-CONT, an operation that affects phonology, to happen after certain operations on the LF, therefore it no longer makes any implications on the division between different modules of grammar.

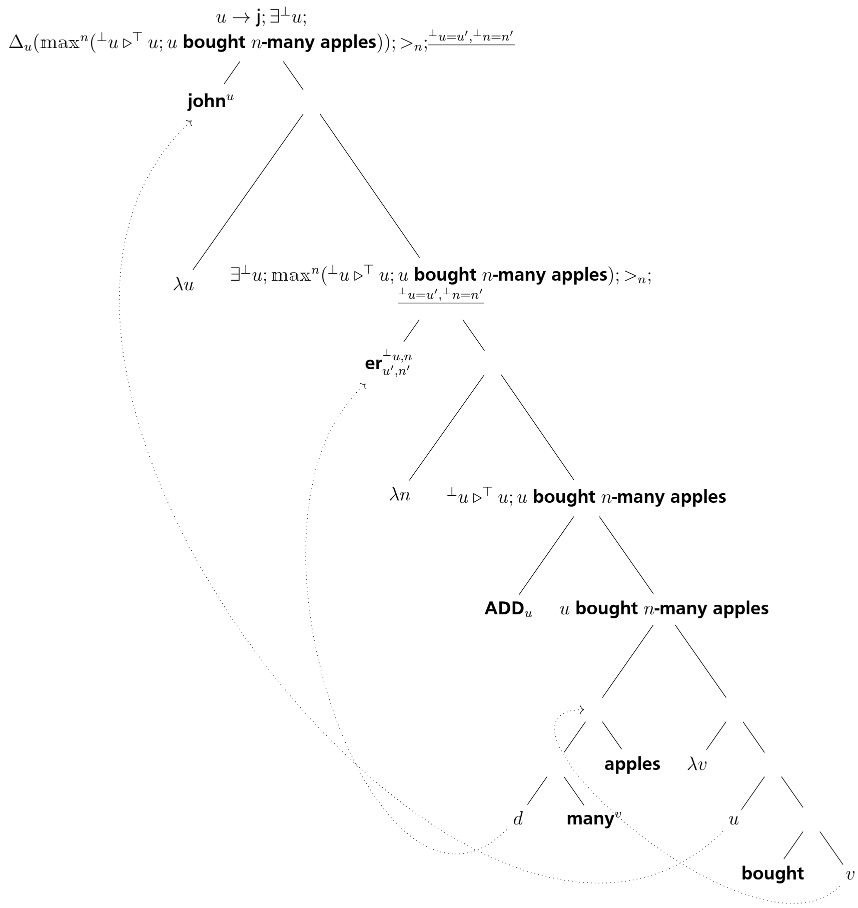



Figure 5.9: Deriving the additive comparison using pairs

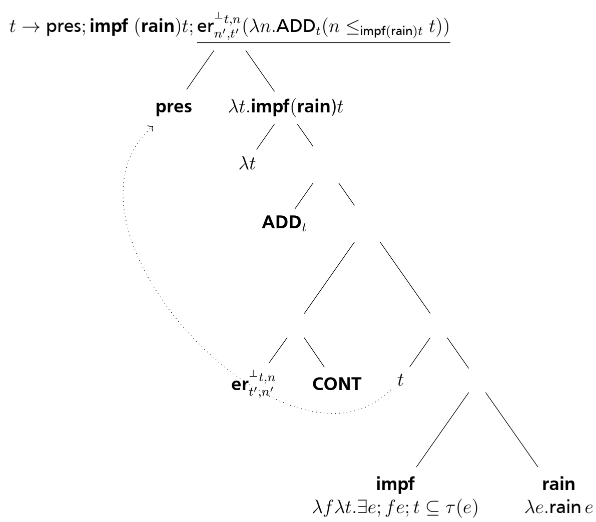



Figure 5.10: Deriving temporal continuation using pairs

### 5.4.2 Comparative anaphora in the internal reading

We can use (75) to derive the same internal reading as in section 5.3 because these two added components could have no observable impact when *er* is in the scope of *every*.

The meaning we arrive at using the same structure (Figure 5.11) is repeated in (87); let the postsuppositional test be discharged in the output context of the distributive update, this is then equivalent to (88). The parts that were not included in the internal reading we have derived in section 5.3 are marked in blue.

(87) $\mathbb{max}^u(\textbf{year}\ u);$

$$\mathbb{D}_u(\exists^{\perp} u; \mathbb{max}^n(\exists z; \textbf{big}(n,z); \textbf{boat}\ z; v \to \textbf{j}; \textbf{buys}(z,v,u)); >_n;^{\underline{\perp u=u', \perp n=n'}})$$

(88) $\mathbb{max}^u(\textbf{year}\ u);$

$$\mathbb{D}_u(\exists^{\perp} u; \mathbb{max}^n(\exists z; \textbf{big}(n,z); \textbf{boat}\ z; v \to \textbf{j}; \textbf{buys}(z,v,u)); >_n); \underline{{}^{\perp}u = u', {}^{\perp}n = n'}$$

Now let's consider the contribution of the two added components in this formula. First, the correlate introduction $\exists^{\perp} u$ is effectively vacuous. Recall that $\mathbb{D}$ distributes over an ordered domain $\overrightarrow{x}$ by requiring the nuclear scope of quantification, $M$, to associate $\langle S|_{u=\{x_n\}}, S|_{u=\{x_0,\ldots x_{n-1}\}}\rangle$ and $\langle I|_{u=\{x_n\}}, I|_{u=\{x_0,\ldots x_{n-1}\}}\rangle$, for any $n$ between

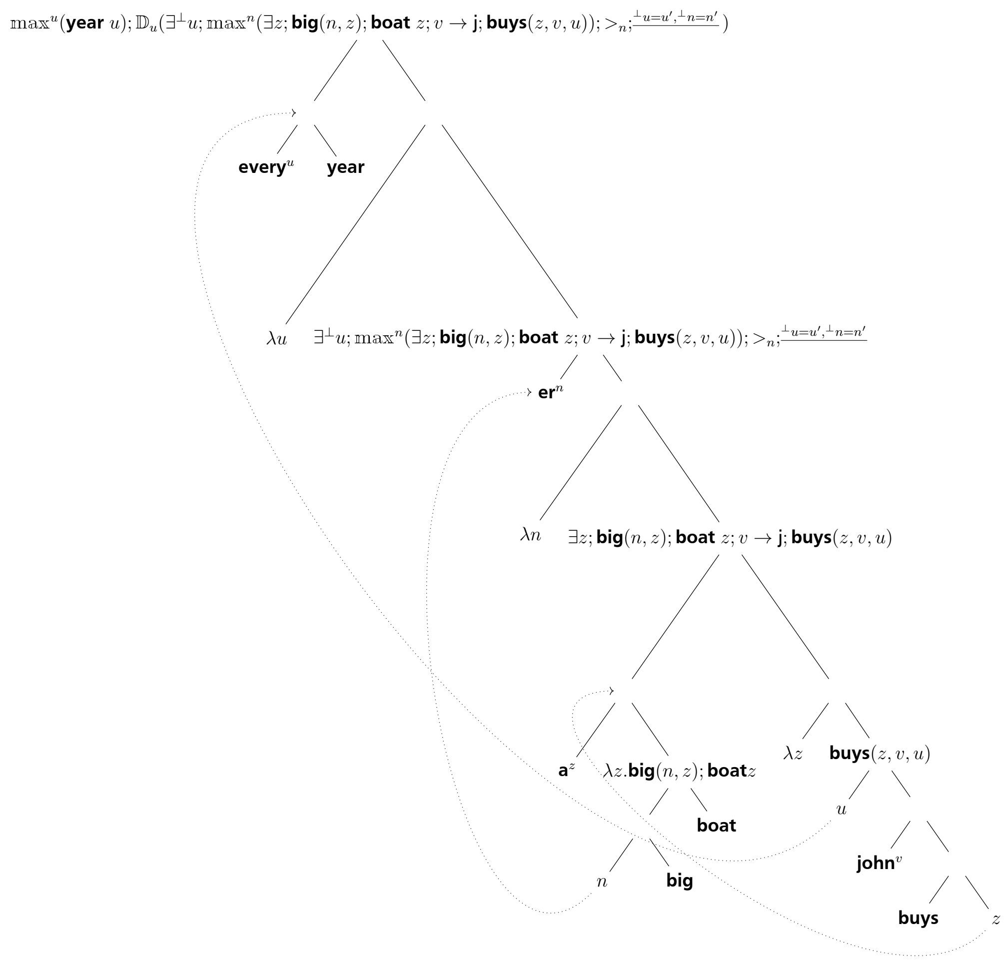



Figure 5.11: Composing the internal reading with the unified, post-suppositional *er*

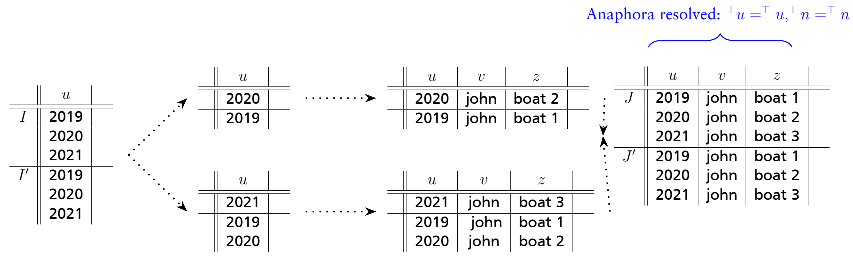



Figure 5.12: Anaphoric test in the internal reading of *every year John buys a bigger boat*

0 and $|\overrightarrow{x}|$ (see (52)). In other words, the definition of $\mathbb{D}_u$ guarantees that the nuclear scope associates two pairs of states with identical $u$-values. Thus, even though $\exists^{\perp}u$ can re-introduce the secondary $u$-value, because it is in the scope of $\mathbb{D}$, this re-introduction is pre-conditioned to be vacuous, i.e., it cannot change the secondary $u$-value or the updates will return false.

Second, the anaphoric test $\underline{^{\perp}u = u', ^{\perp}n = n'}$ can always be satisfied in the local context. Again recall the definition (52): the distributivity operator $\mathbb{D}$ outputs a set of pairs $\langle I, I' \rangle$ where $I = I'$. This means when the postsuppositional anaphoric test is discharged at the output context of the distributive quantification, the test is effectively applied to pairs of identical info states. For instance, in the internal reading of *every year John buys a bigger boat*, the anaphoric test will take the pair $\langle J, J' \rangle$ in Figure 5.12 as its input. Can we find drefs that have the same value as $^{\perp}u$ and $^{\perp}n$ in this pair? Yes – their counterparts in the primary state. So simply by giving the comparative marker the appropriate indices, i.e. $\mathbf{er}^{\perp u, n}_{\top u, \top n}$, the anaphora condition is always satisfied in the output of the distributive update; no clause-external antecedent is called for.

## 5.5 Theory comparisons

Our implementation in section 5.3 crucially differs from the two other previous dynamic proposals in that the alternative degree in the secondary state is anchored to a standard correlate. We have now seen how the correlate-based account – a technical update of the core proposal of this dissertation – can successfully derive the internal reading of scalar comparatives; I have also briefly mentioned that a direct extension of these previous accounts can't achieve the same. This section offers a more detailed discussion of the advantage of the current, alternative-based implementation.

### 5.5.1 Parallelism in a pair

In Brasoveanu (2011), it is suggested that the semantic composition mostly cares only the primary state and leaves the secondary state untouched, the lexicalized universal and the comparative are thus the only exceptions that make use of this additional information channel. For instance, an ordinary predicate only checks if the drefs in the primary states satisfy the lexical relation and ignores the secondary state (89).

(89) $\textsf{\textbf{recited}}(u, v) := \lambda \langle S, S' \rangle \,.\, \{\langle S, S' \rangle \mid \forall s \in S : \textsf{recited}(s_u, s_v)\}$

Unlike in my implementation, in this approach the two states are not always parallel to each other: because information in the secondary state is simply ignored by ordinary predicates, there is no guarantee that all the relations and properties that hold in the primary state also hold in the secondary state. However, for the pair-based distributivity to work as intended in the internal reading, parallelism between a pair is necessary at least in the scope of an universal quantification. Brasoveanu (2011) gets to ensure this parallelism indirectly, by giving *every* the definition in (90). The crucial part is the definition of the distributivity operator $\textsf{\textbf{dist}}_u$: for any two distinct individuals $x$ and $x'$ in the restrictor set of *every*, $\textsf{\textbf{dist}}_u$ ensures that: (i) the nuclear scope $M$ associates the substate in the input primary state $S|_{u=\{x\}}$ and the substate in the output primary state $I|_{u=\{x\}}$; (ii) in the meantime the other substate in the output primary state $I|_{u=\{x'\}}$ is available as the secondary member of both the input and the output pair of $M$. Because for $x \neq x'$ entails $x' \neq x$ for any $x, x'$, this definition guarantees that $M$ will associate $S|_{u=\{x\}}$ and its corresponding substate in the output primary state for any individual $x$ in the domain of *every*. It is this that ensures the CCP in the scope of **dist**$_u$ always has a secondary state in its input pair that is parallel to the primary state – because this substate is manually taken from the primary state in the output primary state.

(90) **every**$^u$ := $\lambda P \lambda Q.$**max**$^u(Pu);$ **dist**$_u(Qu)$

$$\textbf{max}^u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} \langle I, I' \rangle \in \langle S, S' \rangle [M] \\ \neg \exists : \langle K, K' \rangle \in \langle S, S' \rangle [M] : K_u \subseteq S'_u \end{array} \right\}$$

$$\textbf{dist}_u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, S' = I' \\ \forall x, x' \in S_u : x \neq x' \rightarrow \\ \left\langle S|_{u=\{x\}}, I|_{u=\{x'\}} \right\rangle [M] \left\langle I|_{u=\{x\}}, I|_{u=\{x'\}} \right\rangle \end{array} \right\}$$

However, I have explained in section 5.2 that this particular way of pair distributions can't extend to scalar comparatives, due to the asymmetric ordering relations they impose: if $x$ exceeds $x'$ on a certain scale, it is impossible to have $x'$ exceed $x$ on the same scale. Moreover, the first year in *every year John buys a bigger boat* is not required to be a year where John buys a boat bigger than the boats he bought in any other years. My analysis explains these observations by having the pair-distributions follow a fixed ordering. Is it possible to make similar changes to (90)? This is done in (91), where we change condition $x \neq x'$ to $x' \prec x$ (on the given ordering). However, with this change, the first entity in the domain of *every* is no longer in the primary state of any pair, thus for this entity $x$, there is no guarantee that the scope of **dist**$_u$ associates the sub-state in the input $S|_{u=\{x\}}$ to the corresponding sub-state in the output. In other words, with the definition in (91), in the output of *every year John buys a boat*, there is no guarantee that John bought a boat in the first year. This is obviously not a desired result.

(91) $\textbf{dist}_u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, S' = I' \\ \forall x, x' \in S_u : x' \prec x \rightarrow \\ \left\langle S|_{u=\{x\}}, I|_{u=\{x'\}} \right\rangle [M] \left\langle I|_{u=\{x\}}, I|_{u=\{x'\}} \right\rangle \end{array} \right\}$

A possible way out here is to still let the first entity be in the primary state of a pair while making sure that no comparison occurs in that pair. For example, we can give $\textbf{dist}_u$ the definition in (92) and the comparative marker the definition in (93). This $\textbf{dist}_u$ places *every*'s first entity in the primary state of the pair with the dummy individual, thus the nuclear scope of *every* gets to apply to the first entity. In the meantime, the comparison of the $\textbf{er}^{\perp u,n}_{n',u'}$ in (93) is conditional on the $u$-value of the secondary state being not empty; in the pair of the first entity and $\star$, the secondary state $I|_{u=\{\star\}}$ necessarily has an empty $u$-value as its $u$-column contains only the dummy individual, so no ordering relation is imposed – the first entity still doesn't compare to anything. The truth conditions should come out exactly as we want.

(92) $\textbf{dist}_u := \lambda M \lambda \langle S, S' \rangle.$
$$\left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, I|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \exists \overrightarrow{x} \text{ on } S_u : \left\langle S|_{u=\{x_1\}}, I|_{u=\{\star\}} \right\rangle [M] \left\langle I|_{u=\{x_1\}}, I|_{u=\{\star\}} \right\rangle \\ \forall n : 1 < n < |S_u| \rightarrow \\ \left\langle S|_{u=\{x_n\}}, I|_{u=\{x_0, \ldots x_{n-1}\}} \right\rangle [M] \left\langle I|_{u=\{x_n\}}, I|_{u=\{x_0, \ldots x_{n-1}\}} \right\rangle \end{array} \right\}$$

(93) $\textbf{er}^{\perp u,n}_{n',u'} := \lambda f . \exists^{\perp} u; \textbf{max}^n(fn), >_n;$

$$>_n := \lambda \langle S, S' \rangle . \{ \langle S, S' \rangle \mid S'_u \neq \emptyset \rightarrow S_n > S'_n \}$$

Nevertheless, it's hard to see how this approach can be extended to other uses of the comparative. The problem is that even with the fix in (92) - (93), parallelism between a pair is only guaranteed by *every*'s distributivity operator, but we still need the parallelism to get the intended meaning in those other uses. For instance, in the external reading of *Mary read five books, John read more*, we wish to compare

John and Mary on the same measurement relation, i.e., the amount of books they read; yet even if we assign Mary to be the secondary alternative to John, there is no guarantee that the secondary degree is related to her via the same measurement relation that holds in the primary state – or that there is a secondary degree at all – because ordinary semantic relations simply ignore the secondary state. Having a (covert) $\textbf{dist}_u$ is not going to help these cases, because $\textbf{dist}_u$ only pairs up individuals in the primary $u$ value in its input pair and thus will always result in an internal reading.

In Brasoveanu (2011), parallelism is not a concern in the external reading, because the external reading he aims to capture only amounts to anaphora to an individual/degree. Take (94) for example, for Brasoveanu the external reading of *same* here is only anaphoric to the book *War and Peace* in the first sentence. As was first pointed out in Hardt *et al.* (2012), this characterization fails to predict *same*'s sensitivity to a larger context than the individual alone, e.g., it fails to predict that (95) can't license a subsequent external reading of *same* in (95a), even though the book name is still accessible and can be picked up by the individual pronoun in (95a).

(94) Mary read *War and Peace*$^x$. ... John read the same$_x$ book.

(95) Mary didn't read *War and Peace*$^x$. ...

   a. It$_x$ is a boring book.

   b. # John read the same$_x$ book.

### 5.5.2 Association with a non-local licensor

Based on the above considerations, I have chosen to implement the parallelism between a pair in a more straightforward way, i.e., directly encoding it into lexical meanings. As far as I know, this alternative approach dates back to Bumford and Barker (2013).

Different from my proposal, and like Brasoveanu (2011), Bumford and Barker

(2013) still maintains an *in-situ* analysis of comparatives in the internal reading. For instance, the *different* in *a*$^u$ *different poem* stays inside the noun phrase and compares the two poems that the indefinite determiner introduces to the $u$-position in a pair.

The *in-situ* analysis predicts that *a different poem* can only compare between the pair-assignments created by the universal quantifier closest to the containing indefinite. In the second part of their paper, Bumford and Barker show that this prediction fails to expain the systematic ambiguities in sentences like (96):

(96) Every boy gave every girl a different poem.

(96) is ambiguous between a reading where no girl received the same poem from multiple boys, and another reading where no boy gave the same poem to multiple girls. For this very sentence, we can still derive the ambiguity via inverse scope of the second universal or the indefinite. However, even when the scope relation between the multiple universals and the indefinite is fixed, it remains possible for the comparative to be associated with a universal that is non-local in the surface structure. Consider (97):

(97) Every time John's students$^x$ pay him a visit, each of them$_x$ brings a different/longer poem they have been working on.

This sentence has a reading that says each time John's students visit John together, each of them brings a poem that is different/longer than the poem that student has brought last time. To get the internal comparisons across different years, *different/longer* has to be associated with the temporal universal *every time John's students pay him a visit*, but this couldn't be achieved by inverse scope of either the universal or r the indefinite. Here the second universal *each of them* contains a pronoun bound by *John's students* inside the first universal, therefore it has to stay in the scope of the first universal. Scoping the indefinite over *each of them* doesn't help either, it will only give rise to a reading that says every time John only receives one poem from all

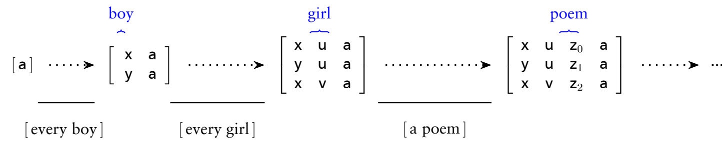



Figure 5.13: Updates of *every boy gave every girl a poem* with lists

of his students combined, which is not the targeted reading where the value of the indefinite co-varies with the value of *each of them*. So the scope configuration of this sentence can only be (98); the comparative gets to be associated with the universal quantifier that is non-local to the containing indefinite.

(98) [Every time John's students pay him a visit $\lambda u$ [each of them $\lambda v$ [a different/longer poem they have been working on $\lambda z$[$uv$ brings $z$]]]]

Bumford and Barker propose an even richer context structure to account for non-local associations (see also Lahm 2016). Instead of relations between pairs, they propose to represent CCPs as relations between *lists* of info states; the length of these lists is unbounded. Each nested universal adds an additional state the list, so at any point of the computation, there will be as many additional states (apart from the first, primary state) as there are dominating universals. For instance, the updates of *every boy gave every girl a poem* now proceed as sketched in Figure 5.13: *every boy* introduces a boy $x$ all the states in its input list and an alternative boy $y$ to the additional state; *every girl* in its scope then introduces a girl $u$ to the context, and an alternative girl $v$ to its own additional state, the third state. Since every universal has its own additional information channel, it is possible for the comparative to select which additional channel it compares to. The non-local associations occur when the comparative selects an additional state that is introduced by a non-local universal quantifier.

In my analysis, there is no need to further complicate the context representation with lists; the non-local associations are simply results of the comparative taking scope independent of its containing noun phrase. For instance, the two readings of (96) can be derived as run-of-the-mill scope ambiguity: the LF in (99) derives the reading that no boy gave the same poem to multiple girls, the LF in (100), where the comparative marker DIFF itself takes scope under the higher universal, derives the reading that no girl receives the same poem from multiple boys[6].

(99) $[\,\text{every boy}\,\lambda x[\,\text{every girl}\,\lambda y[\,\textsc{diff}^{\perp y,n}_{\top y,\top n}\lambda n[\,\text{a } z\text{-ident poem}\lambda z[\,x \text{ gave } yz\,]\,]\,]\,]\,]$

(100) $[\,\text{every boy}\,\lambda x[\,\textsc{diff}^{\perp x,n}_{\top x,\top n}\lambda n[\,\text{every girl}\,\lambda y[\,\text{a } n\text{-ident poem}\,\lambda z[\,x \text{ gave } yz\,]\,]\,]\,]\,]$

Similarly, we can derive the co-variation reading of *Every time John's students pay him a visit, each of them brings a longer poem* using the LF in (101). For every pair of times that the higher universal distributes over, *er* introduces a (plural) degree associated with that year. After maximizing this degree over the nuclear scope update containing the lower universal, what we have in the context are pairs like $\langle I, I' \rangle$ in (102), where the primary $u$-value is the maximal lengths of each poem brought by each student during the first visit, and the secondary $u$-value is the maximal lengths of each poem bought by each student the second time. *er* then imposes its ordering relation on this pair, which gives us $\{\mathsf{d}_1, \mathsf{d}_2, \mathsf{d}_3\} > \{\mathsf{d}_4, \mathsf{d}_5, \mathsf{d}_6\}$. This is true if $\mathsf{d}_4 > \mathsf{d}_1, \mathsf{d}_5 > \mathsf{d}_2, \mathsf{d}_6 > \mathsf{d}_3$, i.e., each student brings a longer poem than the poem they bring the last time.

(101) $[\,\text{Every time John's students pay him a visit}\,\lambda u\,[\,\text{er}^{\perp u,n}_{\top u,\top n}\lambda n[\,\text{each of them}\,\lambda v$
$[\,\text{a } n\text{-long poem}\,\lambda z[\,uv \text{ brings } z\,]\,]\,]\,]$

(102)

[6]Technically, to work with nested universals, we need to at least revise the definition of $\mathbb{D}_u$ to make it distribute the $u$-values in both states of the input pair in parallel:

(1) $$\mathbb{D}_u := \lambda M \lambda \langle S, S' \rangle \left\{ \langle I, I' \rangle \;\middle|\; \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, \exists \overrightarrow{x} \text{ on } S_u, \overrightarrow{x'} \text{ on } S'_u : \\ \forall n : 0 < n < |S_u| \rightarrow \\ \left\langle S|_{u=\{x_n\}}, S|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle [M] \left\langle I|_{u=\{x_n\}}, I|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle \\ \forall n : 0 < n < |S'_u| \rightarrow \\ \left\langle S'|_{u=\{x_n\}}, S'|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle [M] \left\langle I'|_{u=\{x_n\}}, I'|_{u=\{x_0,\ldots x_{n-1}\}} \right\rangle \end{array} \right\}$$

| | $u$ | $n$ | $v$ | $z$ |
|---|---|---|---|---|
| $I$ | 1st time | $d_1$ | student 1 | poem 1 |
| | 1st time | $d_2$ | student 2 | poem 2 |
| | 1st time | $d_3$ | student 3 | pome 3 |
| $I'$ | 2nd time | $d_4$ | student 1 | poem 4 |
| | 2nd time | $d_5$ | student 2 | poem 5 |
| | 2nd time | $d_6$ | student 3 | poem 6 |

I hasten to add that with the meaning we derive, the sentence should also be true, if $\mathsf{d}_4 > \mathsf{d}_2, \mathsf{d}_5 > \mathsf{d}_3, \mathsf{d}_6 > \mathsf{d}_1$, i.e., the truth conditions equal to that each time each student brings a poem longer than *some* student has brought last time. Unfortunately, right now I have nothing to say about whether these cumulative readings actually exist, or, if not, how we may restrict the truth conditions properly. I will leave these questions to future research.

Another advantage of an analysis where the comparative takes scope is that it provides a straightforward explanation for the long-observed island sensitivity in the internal reading, namely that the internal reading can only arise when the licensor is in the same scope domain as the comparative (Carlson 1987, Moltmann 1992). This is exemplified in (103) - (105):

- Complex NP island

(103) Everyone rejects the claim that Mary read a different/the same poem.

# under the internal reading

- *wh*-island

(104) Everyone knows why Mary recited a different/the same poem.

# under the internal reading

- Adjunct island

(105) Everyone laughs when Mary recited a different/the same poem.

# under the internal reading

In all of these sentences, the comparative is separated from the universal *everyone* by an island boundary, and they all lack an every-licensed internal reading. This kind of island-sensitivity is expected in my analysis, because to get the targeted reading, *er* is required to take scope to intervene between its licensor operator $Q$ and the variable bound by $Q$, therefore to derive the internal reading in these sentences requires *er* to take scope over the variable bound by *everyone*, which is an island violation in every of these sentences. In contrast, an *in-situ* approach like Brasoveanu (2011) and Bumford and Barker (2013) will need an additional explanation for this island sensitivity.

## 5.6 Chapter wrap-up

In this chapter, I have provided a way to extend the core proposal developed in earlier chapters – comparatives denote a comparison between two correlates on a given measurement relation – to comparatives' internal readings.

In section 5.2, I have shown that none of the existing compositional treatments of the internal reading of *same/different* can easily extend to that of scalar comparatives. I then propose that the internal reading licensed by lexicalized universals should be uniformly characterized as a series of comparisons between incrementally constructed pairs, following a given ordering on the domain of the distributive quantifier.

In section 5.3, I have given a formal implementation of this idea. The implementation requires an upgrade of the dynamic system we have been using: sentence meanings need to relate two-part contexts, i.e., pairs of information states. With this upgrade, lexicalized universals can distribute over pairs incrementally constructed from its domain, and passes these pairs to the comparative marker in its nuclear scope. We get the desired internal reading as the comparative operator compares between the pairs it takes over from a higher-up universal quantifier. I have also shown that this pair-based account can extend to *same/different* in a completely analogous way, and it is capable of deriving different kinds of internal readings licensed by things other than lexicalized universals.

In section 5.4, I have shown that the lexical entry for comparatives in the internal reading can be extended to provide a unified comparative meaning. Once we add the alternative introduction and the anaphoric postsupposition back, the pair-based lexical entry is merely a reformulation of the analysis developed in earlier chapters and therefore inherits all of its merits. Moreover, pairs provide a way for the comparative to take *parasitic* scope without having to take scope above another operator's abstraction. The two added parts have no observable impacts in the derivation of the internal reading, so we derive the desired meanings as before.

Section 5.5 presents a comparison between my analysis and two most closely related existing theories. I have shown that the main difference between my analysis and Brasoveanu (2011) lies in the way to construct pairs, and that encoding parallelism directly into pairs is the key of unlocking the unified account between scalar comparative and identity comparatives in the internal reading, as well as the unified account between the internal reading and the other uses of comparatives. In comparison to Bumford and Barker (2013), I have shown that my analysis has benefits from letting the comparative take scope: it straightforwardly derives the comparatives' possible association with non-local licensors, and also predicts the island sensitivity in internal readings.

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