On the interpretation of concealed questions

by
Lance Edward Nathan

A.B. Linguistics, A.B. Mathematics
Brown University, 1999

Submitted to the Department of Linguistics and Philosophy
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Linguistics

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2006

Author ....
Department of Linguistics and Philosophy
September 8, 2006

Certified by ....
Kai von Fintel
Associate Professor of Linguistics
Thesis Supervisor

Accepted by ....
Irene Heim
Professor of Linguistics
Head, Department of Linguistics

On the interpretation of concealed questions

by

Lance Edward Nathan

Submitted to the Department of Linguistics and Philosophy
on September 8, 2006 in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy in Linguistics

ABSTRACT

Determiner phrases have the ability to act as "concealed questions" (CQs), embedded questions in sentences like *John knows the time* (i.e., John knows what time it is). The fact that *know* and *wonder* differ in their ability to embed CQs partially motivated the hypothesis (Grimshaw 1979) that verbs select the possible syntactic categories of their complements independently of selection for the semantic type of their complements. Theories of CQ meaning generally follow Grimshaw in assuming them to denote questions, or else take them to denote individual concepts (intensions of individuals; Heim 1979, Romero 2005). This dissertation argue that the former assumption does not easily describe the semantically conditioned distribution of CQs, which can be embedded under only those verbs which allow propositional complements as well as question complements. The latter assumption, on the other hand, incorrectly predicts that any DP with an individual concept meaning can be used as a CQ.

We therefore need a new theory of CQ denotations, and this dissertation proposes that CQs denote propositions, so that *the time* in *John knows the time* actually denotes the proposition that the time is x, where x has the value of whatever the current time might be. In this theory, relatively little machinery is required to restrict the distribution of CQs, and it is possible to restrict propositional denotations to only those DPs which can act as CQs, using facts about relational nouns and the composition of relative clause modification.

Thesis Supervisor: Kai von Fintel
Title: Associate Professor of Linguistics

Acknowledgements

When I was a freshman at Brown University intending to major in art history, I traveled an hour and a half north one weekend to visit a high school classmate of mine at MIT. I was startled by almost every aspect of life on the MIT campus. I returned to Providence with the thought, "All that science! And referring to departments by number? And *buildings*? I could never, ever go there."

Wandering the halls of Brown University as a senior applying to graduate schools, I came across the office of a graduate student with the "top ten lies told by graduate students" posted on the door. The one that stuck with me as somehow being the funniest was "I'm getting so much support from my department."

Graduate school is a learning experience in many ways, and I've learned a lot of linguistics in my time here, but I think the two most surprising lessons have been that I could indeed go to MIT and do something scientific and refer to buildings by number, and that I'd be able to say "My department is giving me so much support" without lying at all. I can't for a moment pretend that these years have been easy, but between being at MIT and getting as much support from my department as I have—financial, emotional, educational—I wouldn't have wanted this any other way.

Foremost among those I must acknowledge are the MIT linguistics faculty; I'm continually impressed by the level of academic honesty and openness. One hears dark and unpleasant stories from other fields, stories of professors who make you work on their own pet projects and never want to hear anything that contradicts their work. It's made me all the more thankful for people like Cheryl Zoll, who didn't hesitate to help me write a phonology generals paper using a theory I think she was skeptical of, and Sabine Iatridou and David Pesetsky, who showed only pleasure and never irritation if I came to them with theories in opposition to their own.

Of those professors not on my committee, I owe enormous debts of gratitude to Alec Marantz and Norvin Richards. Alec was the department head during almost all of my time here, and I never had a problem he wasn't willing to help me with. Norvin acted as an ally and a sounding board, always welcoming me to his office whether I needed him to explain a point of syntax, listen while I talked through my semantic thoughts, or just commiserate about Boston winter weather. He was always in good spirits and always willing to take a break from his work; without him around, I know I would have been much less productive. (Though without me to interrupt him, I can only imagine he would have been twice as productive.)

And then, of course, my committee members are in a category all their own. Danny Fox's eye for pattern and organization may have meant more work for me, as parts of the second chapter moved to the fifth, and parts of the third chapter took their place in the second, all because Danny suggested it; but it meant more work because Danny was absolutely right. At the other end of the spectrum, no detail was too minor and no hole in my theory too small to escape Irene Heim's attention, and with her guiding the repairs my theory went from being rather like a sieve to something that should at least hold water for a while. It's no exaggeration to say that the dissertation would have been much poorer without their input.

At least once while writing, I thought to myself, "I want to send these pages to my advisor, but I can't quite make sense of this formula. Maybe I can write something that doesn't really work and slip it past him?" And then I realized that, no, there was no chance that Kai wouldn't notice something broken, and it was back to work. I couldn't have asked for a better committee chair than Kai von Fintel, who would guide me when I was utterly lost, correct me when I was only slightly lost, and encourage me when I finally found my direction again. It's no exaggeration to say that the dissertation wouldn't exist at all without his help.

Of course, there are many people outside the department to thank; dissertations aren't written in ivory towers. In this case, actually, the dissertation was written in a coffee shop: a special note of appreciation goes to the owners and employees of the Diesel Cafe in Somerville. A dissertator couldn't wish for a nicer and more supportive group of baristas. And the coffee ain't bad, neither.

My family doesn't quite understood what it is I do, but that has never kept them from standing by me through it all. When I told them I was dropping out of college, they were supportive, and when I told them I was returning to college, they were supportive. When I told them I was going to graduate school, they were supportive and proud. It's said that you can't choose your family; I say I didn't need to.

My friends...well, what can I say? You do choose your friends, and I chose well. So many people provided so much support through the writing of this that trying to name them all is neither practical nor possible. To highlight just a few, I don't think I could have stayed sane through this process without Deborah Kaplan, Becca Moskowitz, Marc Moskowitz, Allen Petersen, and Rebecca Rabinowitz there to encourage me, console me, and occasionally feed me.

The final person in need of acknowledgement is by far the most important. When she married me almost exactly a year before this dissertation was defended, she accepted more than any non-academic should have to. She accepted a first year of marriage with a husband whose attention would always be divided between her and his dissertation. She accepted the uncertainties of the academic job market. She accepted a husband who would call her in the middle of the day, or wake her when he came home at midnight, to ask for subtle semantic judgments. She accepted the blank stares she would get whenever she answered the question "So what exactly is your husband working on?" In short, she accepted not only all of my personal quirks but all of my professional quirks as well. The fact that she knew what she was getting into and accepted it all regardless was a blessing; the grace with which she has borne both my career and me, neither one being especially easy to handle, has been nothing short of miraculous. Michelle, this is all for you. Hippo goes on your head.

This dissertation is dedicated to everyone who believed I could do it.
You were right—because it was a self-fulfilling prophecy.

Thank you.

TABLE OF CONTENTS

FOREWORD: HOW TO READ THIS DISSERTATION

I have kept this dissertation as neutral as possible with respect to the syntax. That is to say, very little of the proposals herein rely on one or another particular syntactic theory. I have drawn trees in a GB/Minimalist style and have expressed certain points in terms of movement, but these decisions result less from a theoretical need for category labels and movement and more from familiarity and a desire to maintain continuity with earlier work.

As a result, I have used certain category labels throughout, most notably DP for determiner phrases such as *the governor of Vermont* or *every New England governor* and NP for noun phrases such as *governor of Vermont* or *New England governor*. This need not be taken to reflect any particular theory of constituency or architecture; I use DP and NP primarily as labels, to maintain an often-necessary distinction between the two levels. Additionally, for ease of reading, I have translated the syntactic node labels of earlier authors. In particular, I will consistently use *IP* and *CP* for nodes earlier authors labeled *S*, and will refer to points authors made about the DP or NP even when their actual writing concerns, say, the NP and N′.

Semantically, I have used a type-driven framework like the one spelled out in Heim and Kratzer (1998). (I also follow Heim and Kratzer in switching more or less casually between speaking of semantic objects as sets or as their characteristic functions.) The two primary semantic operations are function application and predicate modification:

(1) *Function Application*
If γ has daughters α and β, and $[\![\alpha]\!] \in D_{\langle\sigma,\tau\rangle}$ and $[\![\beta]\!] \in D_\sigma$, then $[\![\gamma]\!] = [\![\alpha]\!]([\![\beta]\!])$

Predicate Modification
If γ has daughters α and β, and $[\![\alpha]\!], [\![\beta]\!] \in D_{\langle\sigma,t\rangle}$, then $[\![\gamma]\!] = \lambda x_\sigma . [\![\alpha]\!](x) \wedge [\![\beta]\!](x)$

The semantic interpretation brackets $[\![...]\!]$ are shorthand for $[\![...]\!]^{g,w}$, i.e. $[\![text]\!]$ indicates the denotation of *text* (or properly, a binary branching structure for *text*) with an assignment function g at a world and time index w. As nothing here will rely on unbound variables and as variables will be left unbound only very briefly and locally, I will always leave g implicit. On the other hand, I will sometimes include the world and time index, particularly when it is bound:

$[\![sleeps]\!] = \lambda x_e . x$ sleeps
$[\![sleeps]\!]^w = \lambda x_e . x$ sleeps at w
$\lambda w . [\![sleeps]\!]^w = \lambda w_1 . \lambda x_e . x$ sleeps at w_1

Additionally, as I will be working within an extensional framework, certain derivations require intensionalized versions of the operations in (1). Primary among these:

(2) *Intensional Function Application*
If γ has daughters α and β, and $[\![\alpha]\!]^w \in D_{\langle\langle s,\sigma\rangle,\tau\rangle}$ and $[\![\beta]\!]^w \in D_\sigma$, then
$[\![\gamma]\!]^w = [\![\alpha]\!]^w(\lambda w . [\![\beta]\!]^w)$

As with other operations, the intensional versions are type-driven.

Full derivations will consist of a series of lines, each line numbered (with the numbers corresponding to the node labels in the tree provided) and indicating the source of the meaning in that step: ⟦...⟧ indicates a lexical entry; $\varphi(\psi)$ indicates a meaning derived by applying step φ to step ψ via function application; $\varphi \wedge \psi$ indicates a meaning derived by combining steps φ and ψ via predicate modification, and $^\wedge\varphi$ indicating (for historical reasons) intensionalization.

To aid understanding, each line in a derivation will include the semantic type of that step's denotation. Semantic types are expressed in the usual way: *e* for individuals, *t* for truth values, *s* for world/time indices, σ and τ as placeholders where type is unknown or ambiguous (as in the $\langle\sigma, \tau\rangle$ type used above). I use one conventionalized shortcut when writing semantic types: on their own in text, $\langle e, t\rangle$, $\langle s, t\rangle$, and $\langle s, e\rangle$ will appear in full to set them apart, but when part of a larger function or when subscripted to indicate a variable type they will often be written *et*, *st*, and *se* respectively. For instance, $\langle\langle e, t\rangle, \langle\langle e, t\rangle, t\rangle\rangle$ will typically appear as $\langle et, \langle et, t\rangle\rangle$; $P_{\langle e, t\rangle}$ will most often be written P_{et}.

As with syntactic node labels, previous papers on this topic have used widely varying semantic representations. Once again, in the interest of clarity and consistency, I have translated other people's logical formulae into the notation used throughout this dissertation. Part of this process of modernizing notation is abandoning the fairly familiar $^\wedge$ and $^\vee$ operators of Montague semantics. Intensions will be written as explicit λ-abstraction, so that the intension of *Fred knows p*, whose extension is

$$[\![\textit{Fred knows p}]\!]^{w} = 1 \text{ iff } \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p(w_1) = p(w)]$$

is written as the first of the following formulae, and not the second:

$$\lambda w\, [\![\textit{Fred knows p}]\!]^{w} = \lambda w_2 \,.\, \forall w_1 \in \text{Dox}_{\text{fred}}(w_2)\ [p(w_1) = p(w_2)]$$
$$^\wedge [\![\textit{Fred knows p}]\!] = \quad ^\wedge[\ \forall w_1 \in \text{Dox}_{\text{fred}}(w_0)\ [p(w_1) = p(w_0)]\ ]$$

or more commonly,

$$[\![\textit{Fred knows p}]\!]_{\langle s, t\rangle} = \lambda w_2 \,.\, \forall w_1 \in \text{Dox}_{\text{fred}}(w_2)\ [p(w_1) = p(w_2)]$$

Similarly, the extension of an object will involve the explicit inclusion of the variable w_0 (or another appropriate world variable), so that the extension of a proposition *p* is $p(w_0)$ and not $^\vee p$.

Past papers have used different variables for different semantic types—e.g., *u* and *v* for individuals, *x* and *y* for intensions of individuals (Janssen 1984); or *x* and *y* for individuals, $\underline{x}$ and $\underline{y}$ for intensions of individuals (Romero 2005). In this dissertation the only variable names that indicate their types are *d*, a variable over degrees, and *w* and *t*, variables over indices of type *s* (with *t* used when the world is constant and only different times are being considered). In formulae with only one world or time variable, *w* or *t* may be used; otherwise, the variables will have subscripts, with w_0 and t_0 indicating the actual world.

Certain other variables may be used in typical ways—*p* and *q* for variables over propositions, *P* as a variable over sets of individuals—but for clarity, the first occurrence of a variable in a formula (other than *d*, *w*, or *t*) will have its type given as a subscript, e.g.:

$[\![every_{\langle et, \langle et, t\rangle\rangle}]\!] = \lambda P_{et} . \lambda Q_{et} . \forall x_e . [P(x) \rightarrow Q(x)]$
$[\![every_{\langle\langle st, t\rangle, \langle\langle st, t\rangle, t\rangle\rangle}]\!] = \lambda P_{\langle st, t\rangle} . \lambda Q_{\langle st, t\rangle} . \forall p_{st} . [P(p) \rightarrow Q(p)]$

Traces also have their types indicated by subscripts, as do lexical items with more than one type when disambiguation is needed (as with the two senses of *every* above).

To distinguish particular senses of a word while leaving open the exact type, a subscripted word may be used: [*the governor of California*]$_{\text{individual}}$ means "the phrase *the governor of California*, used to denote the individual who is the governor" and [*the governor of California*]$_{\text{CQ}}$ means "the phrase *the governor of California*, used to denote the concealed question 'who the governor is'". Similarly, *know*$_{\text{individual}}$ and *know*$_{\text{CQ}}$ mean, respectively, "the sense of *know* that takes an individual as its complement" and "the sense of *know* that takes a concealed question as its complement."

For ease of reference: this dissertation uses the following abbreviations for linguistic terms (as well as the familiar category labels such as "DP").

ARN/CRN	abstract/concrete relational noun – §4.2.3
CQ	Concealed Question - §1.1
IC	Individual Concept – §3.2
IR	Interrogative Raising – §5.1
PCQC	the Proposition/Concealed Question Correlation – §2.3
PEC/NEC	Positive/Negative Epistemic Commitment – §2.3.1
QVE	the Quantificational Variability Effect – §5.1
RN/NRN	relational/nonrelational noun – §4.1
SS	Specificational Subject – §6.2

Additionally, Beck and Sharvit (2002) is abbreviated B&S, and Dowty, Wall, and Peters (1981) is abbreviated DWP. Finally, many example sentences refer to USNDH, which is the (wholly fictional) University of Southern North Dakota at Hoople.

CHAPTER 1 – INTRODUCTION

1.1. Scope of the Dissertation

The observation that determiner phrases can act as indirect questions dates back to Baker (1968). The sentences in (1) provide a few examples and help illustrate the intuitions about their meanings.

(1) a. Kim knows *the governor of California.*
b. Leslie has forgotten *the capital of Vermont.*
c. Sandy told me *the time of the meeting.*

The relevant readings for this dissertation are those in which the DPs are treated as questions: Kim knows *who the governor of California is*, or Leslie has forgotten *what the capital of Vermont is.* Determiner phrases used in this way are known as *concealed questions* (CQs).

Over the ensuing four decades, a number of different meanings have been proposed for CQs, beginning with the theory that CQs derive transformationally from clausal questions and have the same meaning as their clausal counterparts. Two distributional questions have emerged over the course of this exploration, each theory of meaning coupled with an answer to one or the other. First, which predicates can take CQs as complements? Though the italicized DPs in (1) seem to denote questions, they cannot be arguments of all question-embedding predicates.

(2) a. John knows the capital of Vermont.
b. * John wonders the capital of Vermont.

If CQs have the same denotation as clausal questions, we would expect them to be compatible with *wonder*, which takes a clausal question as its complement.

Second, which nouns can serve as CQs under which circumstances? Clearly *(the) governor/capital/time (of)* all have CQ interpretations, but not every noun does. Even with an equal pragmatic bias in the context, *the department head* and *the semanticist* differ in their ability to have question meanings.

(3) a. The department of linguistics at the University of Southern North Dakota, Hoople, has (like most others) a single head.
John told me the department head.

b. The USNDH linguistics department has a single semanticist.
* John told me the semanticist.

Compare the second sentence of (3b) to a variant with a full question, *John told me who the semanticist is.* That sentence is grammatical and is a natural continuation of the dialogue, and yet *the semanticist* cannot mean *who the semanticist is* in (3b). On the other hand, the noun *semanticist* does not per se exclude a question meaning:

(3) b′. The USNDH linguistics department has a single semanticist.
?John told me the semanticist who teaches there.

In this context, the DP *the semanticist who teaches here* does have a question meaning; the second sentence of (3b′) is equivalent to *John told me which semanticist teaches there.*

Over the course of this dissertation, I will show that previous theories of CQ meanings do not provide adequate answers to these questions. Consequently, I propose that concealed questions denote *propositions*, roughly as in (4).[1]

(4) **The Meaning of Concealed Questions**
$[\![the\ NP]\!] = \iota p_{st}\,.\,[[\exists x_e\,.\,p = \lambda w_1\,.\,[\![NP]\!]^{w_1}(x)] \wedge C(p)]$
"*the NP*" denotes the unique (maximal) proposition such that
(a) for some individual *x*, the proposition is the set of worlds such that *NP* is true of *x* in that world, and
(b) the proposition meets a contextual restriction *C* (most frequently, the restriction is that the proposition is true)

For example, [[*the governor of California*]] is the unique true proposition such that, for some individual *x*, the proposition expresses that *x* is a governor of California. There are many propositions of the form "*x* is a governor of California", but the only true one at the time of this writing is *that Arnold Schwarzenegger is a governor of California*. This captures the truth conditions of *Kim knows the governor of California*, which will be true if Kim knows the proposition that Schwarzenegger is the governor of California.

The theory that CQs denote propositions, like previous theories of CQ meanings, produces the correct truth conditions for basic sentences like those in (1). I will show in this dissertation that it also yields the correct truth conditions for the full range of sentences with concealed questions. It has the added advantage that, unlike previous theories of CQ meanings, it allows a natural account of the facts in both (2) and (3), based on the following two generalizations. First, CQs have a predictable distribution:

(5) **The Distribution of Concealed Questions: The Proposition/CQ Correlation**[2]
A concealed question can fill a predicate's argument position if and only if
(a) the Case requirements of the position are met, *and*
(b) a (clausal) question can fill the position, *and*
(c) a (clausal) proposition can fill the position.

Having CQs denote propositions provides a way to describe this generalization in a way that, as we will see in Chapter 2, having CQs denote questions does not. And second, CQs have a predictable form:

---

[1] Or rather, CQs with definite determiners. Nearly all CQs discussed in previous literature have either a definite article (*the price of milk*) or a possessive pronoun with the same effect (*John's favorite drink*). Heim (1979) also mentions *everything that John does*, and discusses methods for getting *John knows Bill's phone number* to follow from *John knows every phone number*. I will return to CQs with determiners other than *the* in Chapter 4. In the interim, the meaning in (4) is the one to keep in mind as the dissertation progresses.

[2] Henceforth referred to as the PCQC, pronounced *Pickwick*.

(6) **The Form of Concealed Questions**
A DP can be a concealed question if:
(a) its head noun is *relational*: it expresses a relationship between two individuals (e.g. a state and its governor, a commodity and its price), or
(b) its head noun is nonrelational, but is modified in certain ways (e.g. with a relative clause)

Deriving propositional denotations allows these restrictions to be encoded in the compositional semantics in a way that, as we will see in Chapter 3, using individual denotations or their intensions does not.

These facts will come together in Chapter 4. The remainder of this chapter serves as a launching pad for the exploration in the rest of the dissertation. §1.2 lays out some basic facts about CQ interpretation, focusing on constructions that look like CQs but in fact are not; the ways in which they differ will provide a starting point for understanding the meaning of CQs and the predicates that embed them. §1.3 provides a road map of the chapters to follow.

1.2. A Few Things That Aren't Concealed Questions

As a prelude to an investigation of CQ meanings, we should take a moment to understand what is, and what is not, a CQ. While deriving the meanings of CQs will be the focus of later chapters, this section focuses on what those meanings are. In particular, we will distinguish predicates that embed CQs from similar predicates that do not, and distinguish DPs that are CQs from similar DPs that are not; and see that the question meanings that CQs seem to have are only the meanings of identity questions.[3]

1.2.1. CQ-embedding senses of predicates vs. individual-embedding senses

How do we recognize a DP being used as a concealed question? Consider again two of the sentences in (1).

(1) a. Kim knows *the governor of California.*
b. Leslie has forgotten *the capital of Vermont.*

I claimed above that the italicized DPs have the meanings of questions, e.g. *who the governor of California is.* In fact, (1a) and (1b) are ambiguous; while the DPs may have these question meanings, they can also denote individuals, as in the following approximate paraphrases:

(7) a. Kim is friends with the governor of California.
b. Leslie no longer has memories of the capital of Vermont.

However, these meanings of the sentences in (1) are irrelevant to understanding CQs, as the two readings of each sentence use two different senses of the each verb, a "be familiar with" sense of

[3] As mentioned above, I am ultimately claiming that CQs denote identity propositions and not questions. However, I will continue speak of question meanings and paraphrases in this chapter, in order to maintain continuity with earlier literature and to avoid biasing the discussion against older theories from the outset.

know or "no longer be familiar with" sense of *forget* used in (7), and a "hold knowledge about" sense of *know* or "no longer hold knowledge about" sense of *forget* used with CQ meanings.

A number of facts demonstrate that the predicates have two different senses. First, the two readings have independent truth conditions; neither is a special case of the other. Suppose that Kim is friends with Arnold Schwarzenegger from his movie days, but she's been out of the country for a few years and has no idea that he's been elected governor of California. Then (1a) is true with the individual-denoting meaning of the DP, but false with the CQ-meaning. On the other hand, suppose that Kim has never met Arnold Schwarzenegger, and indeed dislikes action movies so much that she wouldn't even be able to distinguish him in appearance from Jean-Claude van Damme or Vin Diesel. Nevertheless, she knows that he's the governor of California. Then (1a) is false with the individual-denoting meaning of the DP, but true with the CQ-meaning. Equivalent arguments demonstrate the independence of the two senses of other predicates (e.g. *forget* in (1b)).

Second, the two senses of the predicates differ as to whether substituting a coextensional DP preserves meaning. Replacing the DP with the rigid designator that names its extension—which for, e.g., (1a)-(1b) gives *Kim knows Arnold Schwarzenegger* and *Leslie has forgotten Montpelier*—results in sentences with only the "(no longer) be familiar with" readings in (7), and without the "(no longer) know a fact" CQ readings at all. Heim (1979) makes a similar observation about substituting a coreferential definite description:

(8) John knows the capital of Italy.
The capital of Italy is the largest town in Italy.
$\vdash$ John knows the largest town in Italy.

The entailment holds for the "be familiar with" *know* which embeds an individual-denoting DP, but not for the "know a fact" *know* which embeds a CQ.

Third, Heim (1979) gives reasons to believe that these verbs are lexically ambiguous—that is, there are two verbs *know*, one which means "to be familiar with" and one which means "to hold certain knowledge", and not a single verb with two senses.[4] For instance, she observes that German uses different words for the two meanings (*kennen* for the former, *wissen* for the latter); and in those dialects of German in which *wissen* can take DP as its complement, the DP has only a CQ meaning.[5]

Heim also notes that the question-embedding meaning of many verbs does not predictably relate to the object-embedding meaning, except in a metaphorical way—such as $reveal_{\text{question}}$ ≈ "to make known" and $reveal_{\text{object}}$ ≈ "to unwrap or unveil". In truth, there is an argument here somewhat stronger than the one Heim offers: not all question-embedding verbs, even those that allow CQs complements, have an object-embedding sense. For instance, *John guessed/predicted the winner of the 2004 World Series* has only a reading in which John guessed or predicted that the Red Sox would win the World Series, and no reading that asserts a relation between John and the Red Sox themselves. (*John guessed/predicted the Red Sox* is grammatical, but only with an elliptical, *John guessed/predicted that the Red Sox...* meaning.) So for at least

4 Heim is arguing against the specific theory that individual vs. CQ interpretation results from a difference in scope, a theory she refutes to an extent sufficient enough that I will not entertain it here, nor will I present the arguments particular to that theory.

5 Other languages make the same distinction (e.g. French *connaître/savoir*, Spanish *conocer/saber*, Norwegian *kjenne/vite*).

some verbs, the CQ-embedding sense cannot derive from an object-embedding sense because the latter does not exist.

For the rest of this dissertation, I will entirely set aside the individual-embedding meanings of these verbs with the assumption that the two meanings of these verbs are unrelated, perhaps due to a lexical ambiguity.[6]

1.2.2. Concealed question denotations vs. other question denotations

As noted above, this dissertation seeks a semantic explanation of the interpretation of CQs. To that end, it is important to distinguish two categories of nouns with question meanings, only one of which will be discussed in this dissertation.

1.2.2.1. Question meanings lacking from CQs

CQs, as they have been discussed in the literature, have a particular and limited meaning. This fact has been somewhat disguised by the variety of paraphrases CQs have been given. For instance, Baker (1968) offers and Grimshaw (1979) repeats the following sentences and their corresponding paraphrases (Grimshaw's 67-68, Baker's 6.1-6.8; emphasis added):

(9) a. James figured out <u>the plane's arrival time</u>.
  b. John refused to tell the police <u>the fellows who had been involved</u>.
  c. Susan found out <u>the place where the meeting was to be held</u>.
  d. Fred tried to guess <u>the amount of the stolen money</u>.

(10) a. James figured out what the plane's arrival time would be.
  b. John refused to tell the police which fellows had been involved.
  c. Susan found out where the meeting was to be held.
  d. Fred tried to guess how much money had been stolen.

These paraphrases make CQs seem to have great flexibility in meaning.

However, this flexibility is an illusion. In fact, the CQs in (9) can all be paraphrased with questions parallel to the one in (10a), underscoring their common meaning.

(11) a. James figured out *what [<u>the plane's arrival time</u>] would be.*
  b. John refused to tell the police *who [<u>the fellows who had been involved</u>] were.*
  c. Susan found out *what [<u>the place where the meeting was to be held</u>] was.*
  d. Fred tried to guess *what [<u>the amount of the stolen money</u>] was.*

In other words, insofar as a concealed question denotes a question, that question is an *identity* question, i.e. one of the form *who X is* or *what X is.*[7]

---

[6] Heim (1979) proposes that CQs do denote individuals and that CQ-embedding senses of predicates, like non-CQ-embedding senses, semantically compose with objects of type *e*. The arguments in this section do not themselves demonstrate that CQs cannot denote individuals; but see §3.1 for arguments against Heim.

[7] The tense of the identity question varies predictably for sequence-of-tense reasons. Note as well that some predicates set particular tense requirements on their complements—e.g. the complement of *predict* must describe an event after the time of prediction, regardless of syntactic form: *#John is predicting {that the Red Sox won the World Series / who won the World Series}*. The identity question (or proposition) paraphrase will have this same

This limitation becomes more obvious when considering other contexts. The following sentences demonstrate that, even though a particular non-identity question meaning might be pragmatically sensible, CQs cannot have those meanings. Thus, questions with copulars such as *where DP is* or *when DP is* and questions with extraction from subject or object position of transitive verbs such as *what DP saw* or *who saw DP* are not possible meanings of CQs. (The latter might be expected because of the extra semantic material, but even a context which supplies that material does not make the CQ meaning available.)

(12) a. Leslie needed driving directions, so I told her *where the capital of Vermont is.*
b. #Leslie needed driving directions, so I told her *the capital of Vermont.*
c. Leslie was studying for a geography quiz, so I told her *the capital of Vermont.*

(13) a. Alex wants to be on time, so I told him *when the class he should attend is.*
b. #Alex wants to be on time, so I told him *the class he should attend.*
c. Alex wants to learn semantics, so I told him *the class he should attend.*

(14) a. Scooter has a list of famous directors, and he's trying to find out who in his class saw each director's first movie, so I told him *who saw the movie directed by Orson Welles.*
b. #Scooter has a list of famous directors, and he's trying to find out who in his class saw each director's first movie, so I told him *the movie directed by Orson Welles.*
c. Scooter has a list of famous directors, and he's trying to find out what movie I saw by each director, so I told him *the movie directed by Orson Welles.*

The (a) sentences in (12)-(14) show full questions embedded under *told*, each of which is pragmatically relevant in the context. Nevertheless, the DPs in the (b) sentences cannot have these question meanings. (Each DP can be used as a CQ in other contexts, as in the (c) sentences; but crucially the CQs in these sentences mean *what the capital of Vermont is*, *what the class he should attend is*, and *what the (contextually-relevant) movie directed by Orson Welles is*—that is, identity questions.)

In fact, a CQ is even limited in what identity question it can represent—while *who DP is* and *what DP is* are possible meanings of a CQ, *which one DP is* is not.

(15) I bought milk at the store (with a couple of other things). The receipt lists three unnamed items: one cost $1.49, the second cost $1.99, and the third cost $2.49.
#I don't know the price of milk.
(cf. *I don't know which one the price of milk is.*)

While *I don't know the price of milk*, meaning *I don't know what the price of milk is*, is true here, the context creates an expectation for a question like *which one of these three prices*, and in that sense the CQ is infelicitous. The meaning of a CQ must be the identity question *who/what X is* and not *which one X is*.

---

restriction, so that for instance the CQ in *John is predicting the winner of the World Series* is better paraphrased *who the winner will be* instead of *who the winner is*. This fact is incidental to the core meaning of the concealed question.

Ben Russell (p.c.) suggested (16) as a possible counterexample to this claim, insofar as one might ask it to find out *when the last train to Boston is*, making the DP a *when*-question and not an identity question.

(16) Tell me the last train to Boston.

However, when speaking of trains (and other scheduled transportation), we habitually identify them by time: in fact, "8:10" is a less appropriate answer than "the 8:10" (and "the Northeast Direct," with no mention of a time, is an equally good answer). While one can ask (16) to learn when the last train is, this is because learning one of the train's names will thereby allow one to learn its time. So the CQ really is the identity question *Tell me what the last train to Boston is.*

The DPs discussed in this section are concealed questions as they have been discussed in the literature. They each appear as the complements to a wide variety of predicates, including *know* and *tell* but excluding *wonder*, and their question meanings derive entirely from the denotations of the DPs themselves, with no added information such as *where...* or *who saw....* These are the hallmarks by which we can recognize CQs, and they will be used as diagnostics throughout this dissertation.

1.2.2.2. Question-denoting DPs that aren't CQs

English has other examples of nouns in certain contexts having question meanings. In this section, we'll look at a few such cases and see how the question-DPs differ from the CQs discussed in the previous section (and elsewhere in the literature).

Chris Barker (p.c.) noticed a context in which a DP can have the meaning of a non-identity question. The verb *teach*, semantically similar to *tell* as a verb of communicating information, embeds both propositions and questions.[8]

(17) a. I taught Leslie that the capital of Vermont is Montpelier.
b. I taught Leslie what the capital of Vermont is.

A DP complement to *teach*, however, denotes a question with more information than a mere identity question.

(18) a. I taught Leslie French. ≈ I taught Leslie how to speak French.
b. I taught Leslie the tango. ≈ I taught Leslie how to dance the tango.

Indeed, a paraphrase with an identity question is inadequate; for (18a) to be true, it is not sufficient for me to have taught Leslie what French is. This would seem to be an example of a CQ with a non-identity-question meaning.

However, the DPs in (18) differ from the CQs discussed above in a number of ways beyond the difference in possible meaning. In the following paragraphs, we will see sufficient

[8] *Teach* sets other restrictions on its complement, which are not by and large relevant here. One restriction worth noting: the complement must be some sufficiently complex or obscure, and possibly relatively unchanging, fact; thus the infelicity of *#I taught John what time it was.* Many proper CQs may sound degraded as the complement to *teach* for this reason: *I taught Leslie the capital of Vermont* is only as felicitous as the sentences in (17). Thus, some indulgence may be needed for *teach* + identity-question-DP examples in this section.

Note, too, that *teach* is not an idiosyncratic case; at the least, *learn* behaves identically.

differences to support not treating these DPs as concealed questions in the sense of the term employed in the rest of this dissertation.

First, the DPs in (18) not only do not have identity question meanings, they cannot occur productively with other CQ-taking verbs, even those compatible with a *how to...* question.

(19) a. *I found out French. (cf. *I found out how to speak French*)
b. *Tell me the tango. (cf. *Tell me how to dance the tango*)

Given that *French* and, arguably, *the tango* are rigid designators, the nonproductivity of these DPs as CQs is unsurprising in light of one of the diagnostics for CQ meanings discussed in the previous section. We saw that substituting co-extensional DPs in general does not preserve their truth conditions, and that substituting rigid designators in particular removes the meanings entirely. With *teach*, a rigid designator can have a question meaning; and substituting co-extensional DPs for the complement of *teach* does preserve meaning.

(20) a. I taught Leslie the language spoken in Paris. (≡ 18a)
b. I taught Leslie the language spoken by Maurice Chevalier. (≡ 18a)
c. I taught Leslie the national dance of Argentina. (≡ 18b)
d. I taught Leslie the dance the Argentinean in *Moulin Rouge!* performs. (≡ 18b)

Interpreting the DPs as CQs (modulo footnote 8), (20a) and (20b) do not have equivalent truth conditions, nor do (20c) and (20d). These facts make the DP complement of *teach* look decidedly un-CQ-like.

CQs and DP complements to *teach* differ in other ways. A pronoun can have a CQ meaning only when its antecedent is itself a CQ, as in (21a), and not when its antecedent denotes an individual, as in (21b). However, pronouns with individual-denoting antecedents can be the complement to *teach*:

(21) a. I know the capital of France! I can tell it to you.
b. I love the capital of France! #I can tell it to you
c. I love the tango! Let me teach it to you.

(Thanks to Ben Russell for this observation.) And finally, Kai von Fintel (p.c.) observed that the approximate paraphrases in (18), which suggest that nouns like *the tango* have the same meaning as questions like *how to dance the tango*, are not entirely accurate: full questions such as *how to dance the tango* apparently denote mere information, whereas infinitives such as *to dance the tango* or DPs such as *the tango* additionally entail ability:

(22) a. Leslie taught me how to dance the tango, but I can't actually perform it.
b. #Leslie taught me to dance the tango, but I can't actually perform it.
c. #Leslie taught me the tango, but I can't actually perform it.

All in all, DPs like those in (18) are sufficiently different from the objects commonly called "concealed questions" in the literature that we ought not expect a single explanation to cover both. If DP complements of *teach* have question meanings, they receive them not through the same sort of uniform semantic change that gives CQs their identity question meanings, but instead via a kind of metonymy, in which the DP stands in for a related question. Thus, *I taught Leslie French* may mean that I taught her to speak French, or that I taught her to read French, or perhaps that I taught her to understand French (but not to speak it herself). How this metonymy works is well outside the scope of this dissertation.

A similar phenomenon can be seen with many verbs of discussion, such as *discuss* itself as well as others like *comment on*.

(23) a. Leslie and Sam discussed Alex's wife.
 b. Leslie commented on the capital of Italy.

While these sentences may describe the same situations as their identity-question paraphrases (e.g. *Leslie and Sam discussed who Alex's wife is*, *Leslie commented on what the capital of Italy was*), they can also be used in situations described by non-identity-question paraphrases (*Leslie and Sam discussed how tall Alex's wife is*, *Leslie commented on why she liked the capital of Italy*).

For the most part, the discussion of complements of *teach* applies here as well. For instance, the non-identity-question senses of the sentences in (23) do not change with the substitution of a co-referring expression, even a rigid designator; the identity-question senses, however, do change. For instance, if (23b) is used to describe a situation in which Leslie commented on why she liked the capital of Italy, then *Leslie commented on the largest city in Italy* is also true, as is *Leslie commented on Rome*; but neither can be used to describe the situation in which Leslie offers her opinion about which city is the capital of Italy. Similarly, if I don't know what the capital of Italy is, but someone tells me that you went to the capital of Italy, I cannot say (24a), because pronouns with individual-denoting antecedents cannot be CQs. If I do know what the capital of Italy is, though, (24b) is fine, though of course it can only mean that I want to discuss Rome, not that I want to discuss what the capital of Italy is.

(24) a. I hear you recently visited the capital of Italy. #I want to learn it.
 b. I hear you recently visited the capital of Italy. I want to discuss it.

In this case, the DP complements to *discuss* and *comment on* are probably not metonymous for questions; more likely, these verbs have the same ambiguity as *know*, in that their complements can be questions (or CQs) but can also be individuals. So the sentences in (23) are each ambiguous:

(25) a. Leslie and Sam $\text{discussed}_{\text{question}}$ $[\text{Alex's wife}]_{\text{CQ}}$.
 a′. Leslie and Sam $\text{discussed}_{\text{object}}$ $[\text{Alex's wife}]_{\text{individual}}$.
 b. Leslie $[\text{commented on}]_{\text{question}}$ $[\text{the capital of Italy}]_{\text{CQ}}$.
 b′. Leslie $[\text{commented on}]_{\text{object}}$ $[\text{the capital of Italy}]_{\text{individual}}$.

It happens that the two senses of these verbs are closer in meaning than the two senses of *know*, and thus one sense can be used in a paraphrase of the other. The non-identity-question paraphrases of the sentences in (23) are not paraphrases of the (a) and (b) sentences in (25), i.e. the non-identity questions do not paraphrase CQs; they are paraphrases of the (a′) and (b′) sentences. So these apparent counterexamples can also be set aside.

1.3. An Overview of the Dissertation

Throughout this dissertation I will be discussing many past approaches to concealed questions. As different researchers have analyzed different aspects of CQs, I will not attempt to introduce all previous theories at once. Instead, I will describe them in detail as they arise. Nevertheless, an overview of the status of our understanding of CQs may serve as a road map for the following chapters, and so I offer one here. But let us first start with a few comments on the meaning of questions.

1.3.1. The distribution and meaning of questions

The papers discussed in later chapters (Heim 1979; Lahiri 2000, 2002; Beck and Sharvit 2002; Romero 2005) use meanings for questions based on Hamblin (1973) and Karttunen (1977). For convenience, I will use Hamblin's question semantics. Because I will not, in the end, assign question denotations to concealed questions, little will depend on this decision.

For both Hamblin and Karttunen, questions denote sets of propositions. The denotation of a proposition is the set of worlds in which the truth conditions for the proposition hold, i.e. the set of worlds in which the proposition is true; or, alternately, a function which maps to "true" those worlds in which the proposition holds. Propositions thus have the semantic type $\langle s, t \rangle$.

(26) $[\![$*that the capital of Vermont is Montpelier*$]\!] = \lambda w_1$. Montpelier is the capital of VT in w_1

A question then denotes the set of propositions that are answers to the question. (Hamblin takes the set to contain all answers, and Karttunen, only the true answers; but given the intensions of the sets, either one can be derived from the other.) For instance, the question *What is the capital of Vermont?* (or its embedded variant, *what the capital of Vermont is*) denotes the set of propositions of the form *that* x *is the capital of Vermont*. The set may be given explicitly, as in (27a), but is often described schematically as in (27b).

(27) a. $[\![$*what is the capital of Vermont*$]\!]$ =
{that Montpelier is the capital of Vermont,
that Boston is the capital of Vermont,
that Burlington is the capital of Vermont, ...}

b. $[\![$*what is the capital of Vermont*$]\!]$ =
$\lambda p_{st} . \exists x_e . p = \lambda w_1 . [x \text{ is the capital of Vermont in } w_1]$

Another aspect of question meanings, one we will return to occasionally over the course of the dissertation, is exhaustivity. While a question denotes the set of all propositions which answer it, the truth conditions of a sentence with an embedded question do not always depend on all the propositions. Typically, three levels of exhaustivity are discussed. For a *strongly exhaustive* reading, all the answers to the question are relevant, true or false; for a *weakly exhaustive* reading, only the true answers are relevant; for a *mention-some* reading, only one true answer is relevant. For example:

(28) John knows who has access to the supply closet.

Strongly exhaustive reading:
For everyone who has access to the supply closet, John knows that they have access; and he knows that no one else does.

Weakly exhaustive reading:
For everyone who has access to the supply closet, John knows that they have access.

Mention-some reading:
For someone who has access to the supply closet, John knows that they have access.

Suppose that three people in an office (A, B, C) have access to the supply closet. If John is an administrative assistant, one might say (28) with its strongly exhaustive reading; someone who asks *Does John know who has access to the supply closet?* wants to be sure that John has complete knowledge of closet access. If John has a cubicle near the supply closet, one might say the sentence with its weakly exhaustive reading: he's seen A, B, and C access the closet, so he knows they have access, but he can't be sure there's not someone else with access who happens not to have come by yet. And if John just works somewhere in the office, one might say the sentence with its mention-some reading: he might not know that all three of them have access but only that B does, because he goes to B whenever he needs something from the closet.

Many authors (see especially Heim 1994, Beck and Rullmann 1999) have investigated exhaustivity, offering formal operators to produce the different meanings. In this dissertation, we will not need to explore exhaustivity meanings in this detail; the authors discussed herein for whom exhaustivity is an issue (Beck and Sharvit 2002, Lahiri 2002) offer sufficient explanations of their own theories' abilities to capture all the correct meanings.

A final point before moving on from questions to concealed questions: Karttunen (1977) divides question-taking predicates into nine categories.

(29)
a. verbs of retaining knowledge: *know*, *be aware*, *recall*, *remember*, *forget*
b. verbs of acquiring knowledge: *learn*, *notice*, *find out*, *discover*
c. verbs of communicating (knowledge): *tell*, *show*, *inform*, *indicate*, *disclose*, *reveal*
d. decision verbs: *decide*, *determine*, *specify*, *agree on*, *control*
e. verbs of conjecture: *guess*, *predict*, *bet on*, *estimate*
f. opinion verbs: *be certain*, *have an idea*, *be convinced*
g. inquisitive verbs: *ask*, *wonder*, *investigate*, *be interested in*
h. verbs of relevance: *matter*, *be relevant*, *be important*, *care*, *be significant*
i. verbs of dependency: *depend on*, *be related to*, *have an influence on*

(adapted from Karttunen 1977, 8)

Karttunen's divisions are not the only possible divisions, nor even necessarily the most useful from a theoretic standpoint. The categories are not syntactically homogenous, as a single category may include both adjectives and verbs (*be relevant* and *care*) or both transitive and ditransitive verbs (*reveal* and *tell*). Nor are they even semantically homogenous: many sections of this dissertation will explore the ways in which *ask* differs from *wonder*.

So no theoretical point will rely on these categories. However, it is useful to have a list of predicates to use in testing question and concealed question complementation, and I will use the divisions to simplify discussions of empirical generalizations. And with that, we can move from questions to concealed questions.

1.3.2. The distribution and meaning of concealed questions

This dissertation comprises four main chapters. The first two examine other theories of CQ meanings, and the third and fourth propose and defend the new theory.

We begin in Chapter 2 by considering whether CQs can simply denote questions. §2.1 demonstrates that assigning question denotations to DPs is possible, and that they adequately capture the meaning of CQs. However, as some predicates (like *wonder*) are compatible with question-denoting clauses but not question-denoting DPs, this theory of CQ meanings must be supplemented with an explanation of CQ distribution. Consequently, §2.2 examines what this explanation might be.

Grimshaw (1979), discussed in §2.2.1, takes concealed questions to have meanings identical to clausal questions but argues that CQs enter the derivation as DPs and are not derived (as in Baker 1968). This allows her to explain why CQs have a different distribution than clausal questions do; she proposes that predicates are lexically marked for syntactic selectional properties and semantic selectional properties. Therefore, some predicates allow DP complements, some allow CP complements, and some allow both; some predicates allow propositional complements, some allow interrogative complements, and some allow both. The property of embedding concealed questions is the conjunction of two independent properties, namely allowing DP complements syntactically and allowing interrogative complements semantically.

§2.2.2 continues with Grimshaw (1981) and Pesetsky (1981), both of whom expanded on this notion. The former offered an explanation for the incompleteness of the strict independence of syntactic and semantic complementation (why, e.g., no predicates allowed DP questions but not CP questions). The latter related syntactic complementation to Case selection, arguably needed in the grammar for independent reasons. Both, however, maintained the central result of Grimshaw (1979): accepting or not accepting CQ complements is an arbitrary property, specified lexically for each predicate.

§2.2 concludes by observing that these syntactic theories of distribution cannot, by their very nature, explain a semantic condition on distribution. This leads the way to a search for a semantic explanation of distribution in §2.3, beginning with Dor (1992), who postulates a correlation between a verb's "epistemic commitment" (whether the subject necessarily knows the answer to the embedded question) and its ability to embed CQs. His theory goes against the conclusions of Grimshaw and Pesetsky, as he argues that, while CQ-embedding is not a property of all question-embedding predicates, it is not arbitrary either. While his particular proposal turns out to be empirically inadequate, it lays the groundwork a semantic approach instead of a syntactic approach, which brings us to the Proposition/Concealed Question Correlation (PCQC) mentioned above in §1.1. After considering a number of apparent counterexamples in §2.3.2 and explaining them via Case, the chapter finishes by concluding that enough evidence supporting the PCQC exists to justify finding another meaning for concealed questions, one that will permit a semantic characterization of their distribution.

Chapter 3 explores another commonly proposed meaning for CQs, namely individual concepts (ICs). It begins in §3.1 with the theory from Heim (1979) that CQs are simply DPs that denote individuals, but it will rapidly become clear that neither Heim's particular approach, nor any other theory that treats CQs as individual-denoting objects, can explain the data. §3.2 introduces individual concepts, which are the intensions of individual denotations, starting with the original motivation in Montague (1973) to postulate their existence, and continuing with the proposal in Romero (2005) that CQs denote ICs. Romero ultimately argues for a unification of CQs and specificational subjects of copular sentences (e.g. *The number of planets is nine*, as opposed to *the number of planets is large*), a point I will return to briefly in the conclusion. §3.2.2 concerns only those parts of the paper about CQ meanings, including a discussion of an ambiguity in a sentence first noted in Heim (1979) and how IC meanings can produce the correct truth conditions for both readings.

§3.2.3 considers the relation of Romero's theory to the PCQC as developed in the previous chapter, and comes to the conclusion that, while it doesn't provide an easy explanation of the correlation, it at least admits the possibility. The theory does not, however, do as well with the issue of the form of CQs, as we will see in Sections 3.3 and 3.4. The former section presents some of the challenges for the individual concept theory, including suggestions from Janssen (1984) that IC meanings are fairly widespread through the grammar, and are therefore available to DPs that do not have CQ uses. In particular, ICs can be used as the subject of *change*, as titles that refer to people in index-dependent ways, and as certain nouns that vary over time (such as *home*). The latter section follows up on this suggestion with Lasersohn (2005), who proposes that nouns like *price*, which Montague set apart from other common nouns as having intensional meanings and which Romero uses as an IC-denoting CQ, should have the same kind of lexical denotation as other, extensional common nouns. Instead, he concludes, IC meanings can be derived from definite descriptions and should not be part of a lexical denotation.

With IC meanings available for any definite DP, but only some definite DPs usable as CQs, Romero's proposal runs into trouble. The basis of Chapter 4, therefore, is the need to find a meaning for Montague's "intensional" nouns that is not grounded in individual concept meanings. After §4.1 sets out the distinction between relational nouns and nonrelational nouns (alluded to in (6) as a way to separate DPs that can have CQ meanings from those that cannot), the chapter considers ways to introduce IC meanings into the grammar other than doing so lexically, following Montague, or doing so by intensionalizing definite descriptions, following Lasersohn. §4.2 looks at the effect of quantifying over a set of ICs, first seeing what meanings such quantification can have, and then seeing how to derive the correct sets from the lexical denotations of relational nouns and of nonrelational nouns.

This examination of quantified ICs provides a clear understanding of what lexical denotations we have available for relational and nonrelational nouns. §4.3 uses the differences in available denotations to derive propositional meanings for DPs. It starts in §4.3.1 with relational nouns, offering a type-shifting operation applicable only to relational-noun denotations and demonstrating how this theory, too, can capture both readings of the ambiguous sentence discussed by Romero. §4.3.2 then considers how certain nominal modifiers turn nonrelational nouns into CQs, while other forms of modification do not.

By the end of Chapter 4, we will have seen how to assign propositional meanings to DPs, which encompasses the observed restrictions on the form of a CQ. In Chapter 5, we return to the issue of CQ distribution and the PCQC. The theory that DPs denote propositions predicts a stronger correlation—namely, that propositions and CQ should have exactly the same distribution. The qualification that this is true only in Cased positions having been introduced at the end of Chapter 2, this final chapter will cover three other problematic kinds of predicates. §5.1 discusses those predicates that do not embed questions at all, such as *believe*. The proposed solution draws inspiration from Lahiri (2000, 2002), whose theory of Interrogative Raising interprets question complements of proposition-embedding predicates by moving the question and leaving a propositional trace, thereby opening it to the same challenge from a predicate like *believe*.

§5.2 discusses *decide*, which Beck and Sharvit (2002) argue does not embed propositions on one of its question-embedding meanings, and reaches the conclusion that the verb's inability to take propositional complements in fact lies in the presupposition it places on its complement, in combination with other effects that can be isolated. §5.3 takes up the remaining problematic predicates, *depend* and *ask*, the latter being perhaps the most difficult predicate for any theory of CQ distribution—all the more so because it is often taken as a prototypical CQ-embedding verb. While neither accepts propositions as arguments, they also accept only a limited range of DPs, far fewer than the full range of CQs: in fact, the complement of *ask* must be a relational noun, and the subject of *depend* must be a particular kind of relational noun. Thus, neither verb needs to compose with DPs in the same manner that CQ-embedding verbs compose with their arguments.

The concluding remarks in Chapter 6 will offer a sketch of how the proposal in this dissertation may fit into a larger picture, including the reincorporation of CQs into Romero's (2005) theory of specificational subjects of copular sentences and speculations on CQs cross-linguistically.

CHAPTER 2 - WHY CONCEALED QUESTIONS DO NOT DENOTE QUESTIONS

A natural starting point for concealed questions meanings might be to assume that they denote questions; after all, as we saw in the introduction, their meanings can be paraphrased with clausal questions. In this chapter, we will begin by considering whether question denotations can in fact capture the CQ meanings, and see that they do seem to be adequate. Giving CQs the same denotations as questions, however, forces us to consider the difference in distribution between questions and concealed questions. If they contribute identical meanings to sentences, the difference in distribution cannot be explained semantically; consequently, we will have to entertain a syntactic explanation.

Ultimately, I will propose the rough descriptive generalization in (1).

(1) **The Proposition/Concealed Question Correlation (PCQC)** (approximate version)
In argument positions where questions are acceptable, propositions and concealed questions have the same distribution.

An explanation that relies on syntactic facts without reference to the semantics cannot explain such a correlation, if it is true. On the other hand, this correlation seems unlikely, or even false, at first glance: some question-embedding verbs follow the correlation, but others contradict it. In fact, the verbs *know*, *ask*, *care*, and *wonder* seem to suggest the lack of any such correlation. All four allow clausal questions as complements with equal ease.

(2) Kim {knew/asked/cared/wondered} how late it was.

Nevertheless, as the paradigm in (3) shows, the verbs behave differently with respect to propositions and CQs, exemplifying all four possible behaviors instead of the two predicted by the correlation. *Know*, embedding both propositions and CQs, and *wonder*, embedding neither, follow the correlation. But *ask* allows CQs but not propositions as its complement; *care* allows propositions but not CQs.

(3)	a.	Kim knew...	...the time.	...that it was after 5 pm.
	b.	Kim asked...	...the time.	*...that it was after 5 pm.
	c.	Kim cared...	*...the time.	...that it was after 5 pm.
	d.	Kim wondered...	*...the time.	*...that it was after 5 pm.

In this chapter, we will see that, contrary to this superficial examination, the correlation is an accurate generalization for most of the data. Consequently, an explanation of CQ distribution must be sensitive to semantic facts, and as a theory in which CQs have question meanings apparently cannot, we will need to explore other possible meanings.

§2.1 discusses question denotations: how they can be assigned to CQs, whether they adequately capture the meanings of CQs, and what predictions they make about CQ distribution. We will see that there is no immediate semantic reason to rule out question denotations, but that taking CQs to denote questions requires a framework of selection for syntactic categories. §2.2 examines Grimshaw (1979) and Pesetsky (1981), who offer the necessary framework to distinguish the roles of syntactic and semantic selection. They argue for a lack of correlation between, on the one hand, syntactic selection for CPs or DPs, and on the other hand, semantic selection for proposition meanings or question meanings. It will become apparent that using selectional properties of predicates provides no basis to explain a semantically conditioned distribution of a particular syntactic category.

In §2.3, we will look for ways in which the (syntactic) distribution of question-denoting DPs correlates with the semantic property of embedding propositions. §2.3.1 looks at the account of Dor (1992), an earlier explanation of CQ distribution based on semantic facts; §2.3.2 presents data suggesting that the correlation presented in (1) is correct. Consequently, a predicate's compatibility with CQs is not accidental but predictable; and insofar as it requires the predicate-by-predicate specification described in §2.2, the theory that CQs denote questions cannot be correct.

2.1. How Concealed Questions Could Denote Questions

To begin, we need a method to derive question meanings for concealed questions, and as a starting point we can follow Baker (1968) and treat a CQ as an interrogative clause that has undergone a deletion process.

(4) Kim knows [$_{CP}$ ~~who~~ the governor of California ~~is~~].

In this case, it's clear how the object of *know* gets the meaning of the clausal interrogative: the object really is a clausal interrogative, the identity-question meaning coming from material deleted before pronunciation.

Once we look at this possibility in further detail we can see that, unless we stipulate additional restrictions, this theory allows any question-embedding verb to embed CQs and allows any DP to have a CQ meaning.

(5) a. * Kim wonders [$_{CP}$ ~~who~~ the governor of California ~~is~~].
b. * Kim knows [$_{CP}$ ~~who~~ Arnold Schwarzenegger ~~is~~].

The theory presented in Grimshaw (1979), which appears in the next section, rejects this approach on the basis of (5a): *wonder* accepts an interrogative CP such as *who the governor of California is* as its complement, and would therefore also accept an object with the same semantic type and syntactic category even though it happens to have had some words deleted. Instead of restricting *wonder* to keep it from taking "[$_{CP}$ ~~who~~ the governor of California ~~is~~]" as its complement, the grammar could restrict the deletion process from applying to the CP object of *wonder*; but this requires allowing a local syntactic operation to be sensitive to the semantics of the rest of the sentence, which seems unlikely at best, and is more likely simply outside the power of the grammar. The same objection applies to (5b), which can only be ruled out if the syntactic transformation is sensitive to the semantic difference between the two expressions *the governor of California* and *Arnold Schwarzenegger*.[1]

[1] Of course, there is also a syntactic difference between the two expressions, but we saw in the introduction that *the semanticist* and *the semanticist who teaches at USNDH* differ in their abilities to be CQs, and the syntactic difference between these two expressions is, if not more subtle, at least at a deeper point in the derivational process, a depth which should be invisible to the syntactic deletion transformation at the clausal level.

A more promising approach would be to treat the CQ as a DP, rather than a CP, and shift the denotation to the denotation of a question. This shift must apply to the intension of the type-e denotation, as otherwise *the governor of California* and *the star of Total Recall*, which have the same type-e denotation in w_0, would denote the same question; nevertheless, *John knows the governor of California* and *John knows the star of Total Recall* are not synonymous on their CQ readings. (In the introduction, we saw the same point about *the capital of/largest town in Italy*, from Heim 1979.) An operator that turns the intension of a definite description into an identity question is easy enough to write; it should add exactly the meaning of *who...is* in the compositional meaning of the identity question. Something like (6) should suffice:

(6) $\langle s, e\rangle \rightarrow \langle st, t\rangle$
$\lambda x_{se} \,.\, \lambda p_{st} \,.\, [\exists y_e \,.\, p = \lambda w_1 \,.\, [x(w_1) = y]]$

...where "$= y$" corresponds to the meaning of the copula and the trace left by *who*, the rest corresponding to the meaning of the question morpheme. (Heim 1979 suggests a similar shifting operation in formula 7 on page 52.)

In a moment, we will consider the empirical predictions of this approach, but let us first take a few paragraphs to consider whether question meanings capture the range of CQ meanings. Heim in particular addresses the issue of whether question meanings are adequate. She focuses on the following distinction (her (8) and (9), attributed to Greenberg 1977):

(7) a. John found out who the murderer of Smith was.
b. John found out the murderer of Smith.

Although in the last chapter we spoke of sentences like (7a) as paraphrases for those like (7b), Greenberg observes that the former has an additional meaning absent in the latter. For the sake of concreteness, let the facts be that Jones is the murderer of Smith, and that additionally Jones is the chair of the USNDH linguistics department. While the sentence with a concealed question must mean that John now knows that Jones murdered Smith, the sentence with a clausal question can also mean that John now knows some other fact about Jones's identity—for instance, John found out that Jones (i.e. the murderer of Smith) is the chair of the USNDH linguistics department, even if he knows nothing about the murder. (In fact, though Heim does not say so, (7a) has a third reading: without knowing anything about Jones, John may have gathered evidence that whoever it was that murdered Smith also serves as chair of the USNDH linguistics department. As it happens, (7b) lacks this meaning as well.)

Ultimately, Heim does not really reject question meanings for CQs; she sets aside the possibility for "practical" reasons, namely that with the tools available (in particular, giving the DP wider scope), this latter meaning cannot be predicted for (7a), and therefore it is hard to see whether (7b) can be kept from having it as well. As practical reasons go, this one is fairly sensible, but in the interest of being thorough I would like to suggest a way to predict the extra reading of (7a) without also generating it for (7b), so that we can give the CQs-as-questions theory as much consideration as possible.

Based on the shifting operation given before, we know we want *the murderer of Smith*, as well as *who the murderer of Smith is* on its synonymous reading, to denote the following set of propositions.

(8) $[\![$*who the murderer of Smith is*$]\!]^w = \lambda p_{st} \, . \, \exists y_e \, . \, p = \lambda w_1 \, . \, [y = \text{murderer-of-Smith}(w_1)]$

For John to "find out the murderer of Smith", or to "find out who the murderer of Smith is" in this sense, there must be some individual y—in this case, Jones—such that John knows that, in the actual world, "the murderer of Smith" refers to y. Heim shows that our current question semantics predicts this meaning without a problem, so let us move on to the other two readings. In (9b) we have a plausible denotation for the question *who the murderer of Smith is* on the reading where John knows of Jones, the actual murderer of Smith, that he has some other identifying property; in (9a), we have a denotation for the reading where John knows of the murderer of Smith, whichever individual he happens to be, that he has some other identifying property.

(9) a. $[\![$*who t.m.o.S. is*$]\!]^w = \lambda p_{st} \, . \, \exists x_{se} \, . \, p = \lambda w_1 \, . \, [\text{murderer-of-Smith}(w) = x(w_1)]$

b. $[\![$*who t.m.o.S. is*$]\!]^w = \lambda p_{st} \, . \, \exists x_{se} \, . \, p = \lambda w_1 \, . \, [\text{murderer-of-Smith}(w_1) = x(w_1)]$

These two meanings, like the meaning in (8), are sets of identity propositions, propositions which assert of individual A and individual B that they are the same individual—y, $x(w_1)$, murderer-of-Smith(w_1), and murderer-of-Smith(w) are all expressions with type e. What the two meanings in (9) have in common, and what distinguishes them from the meaning in (8), is that in these latter two the propositions in the set differ over an $\langle s, e \rangle$-type *property*, where the propositions in the former differ over an e-type *individual*.

This difference makes it easy to generate the meanings in (9) for a clausal question without generating them for a concealed question. Concealed question denotations come only from the semantic composition of DP denotation and the shifting operation in (6), so that they can never have the denotations in (9). Clausal question denotations, on the other hand, contain additional sememes, notably the denotation of the interrogative pronoun and its corresponding trace. By interpreting the trace as a variable of type $\langle s, e \rangle$ instead of type e, the semantics of questions has the flexibility to produce both denotations in (9).

At this point, we should follow Heim's admonition "to remember that this paper is not supposed to be about puzzles in the semantics of wh-, i.e. overt, questions, and that we are primarily trying to determine whether an adequate interpretation of concealed questions is likely to result from" the type-shifting approach (p. 54). Unlike Heim, though, we can conclude that treating CQs as having the same denotation as clausal questions is at least possible, and perhaps even plausible, in terms of the semantics.

Having accepted question meanings for CQs, we can now return to the empirical, distributional questions. To solve the question of why not all DPs have CQ uses, the shifting operation that produces question denotations might be restricted to apply only to certain DPs but not others. It is not obvious to me how this might be done, especially in a non-stipulative manner, as the operation above shifts the DP denotations and cannot distinguish, in type or meaning, DPs composed from different NPs. That is, given any DP with an $\langle s, e \rangle$ denotation, the shifting operation will turn it into a DP with an $\langle st, t \rangle$ denotation, and does not have reference to the syntactic or semantic qualities of the NP that might distinguish a possible CQ like *the capital of Vermont* or *the semanticist who teaches at USNDH* from a non-possible CQ like *the large city in Vermont* or *the semanticist*. Let us set this problem aside, assuming for the sake of argument that a type-shifting operation applying to the NP and thus sensitive to its characteristics could replace the operation in (6) that applies to the DP.[2]

The other distributional question—which verbs allow CQ complements—seemed impossible to answer on the approach that treated CQs as CPs, as it predicted CQs to appear as the object of any predicate that can embed an interrogative CP. If instead CQs are DPs with clausal question denotations, we cannot characterize their distribution with only semantic facts, but we may be able to do so with a syntactic explanation. In the next section, we will see how.

2.2. A Lexical/Syntactic Explanation of Concealed Question Distribution

Both Grimshaw (1979) and Pesetsky (1981) explain the distribution of concealed questions based on the assumption that they denote questions. In the next section we will consider the former, which relies entirely on lexical specification; following that we turn our attention to the latter, which derives some of that specification from independent syntactic principles.

2.2.1. Grimshaw (1979): the Autonomy Hypothesis

In Grimshaw (1979), we find a two-part proposal to explain the distribution of complements with various syntactic and semantic forms. The first part of the proposal is the presence of two subcategorization systems in the lexicon, which she terms *c-selection* (the selection a predicate makes for the syntactic category of its complement) and *s-selection* (the selection a predicate makes for the semantic type of its complement). Predicates are lexically specified for both: each verb allows certain kinds of syntactic phrase as its complement, and certain kinds of semantic meaning.

To demonstrate the effects of c-selection, Grimshaw considers CP and DP complements, as well as the possibility of null complements. For s-selection, Grimshaw discusses propositions and interrogatives and, additionally, *exclamatives*, illustrated in their matrix form in (10).[3]

---

[2] Rigid designators, as we have seen, also have no CQ reading; this may seem problematic for a theory which turns DPs into question, as on the surface the identity question about a rigid designator—e.g., *Who is Arnold Schwarzenegger?* or *John knows who Arnold Schwarzenegger is*—seems meaningful. But the question is meaningful only with the readings expressed in (9); a concealed question meaning for the rigid designator *Arnold Schwarzenegger*, following (8), would be:

(i) $\lambda p_{st} . \exists y_e . p = \lambda w_1$ [y = Arnold Schwarzenegger]

As there is only one *y* such that *y* is Arnold Schwarzenegger, this is the singleton set containing the proposition "that Arnold Schwarzenegger is Arnold Schwarzenegger"—a trivial proposition, enough to allow us to rule out question denotations for rigid designators on wholly pragmatic grounds.

[3] These types were sufficient to demonstrate Grimshaw's conclusions, but they are not the only types (nor did Grimshaw claim they were). For instance, imperatives form a different semantic category. Imperatives have a syntactic form distinct from declaratives, interrogatives, and exclamatives; in addition to a matrix form they have an embedded form which can be the complement of some verbs but not others (and which can be distinguished from embedded declaratives by the use of the subjunctive mood); and they also have a "concealed" form with a distribution different than the embedded clausal form:

(i) a. The king ordered that the traitor {be/*was} executed. (command, *proposition)
b. The king asked that the traitor {be/*was} executed. (command, *proposition)
c. The king knew that the traitor {*be/was} executed. (proposition, *command)

(10) a. How tall Susan is! (≠ *How tall is Susan?*)
b. What a fool Susan is! (≠ *What fool is Susan?*, *How foolish is Susan?*)

Matrix exclamatives show *wh*-movement but, unlike interrogatives, no subject-Aux inversion. As neither interrogatives nor exclamatives exhibit subject-Aux inversion when embedded, some clauses are ambiguous between exclamations and questions. Adding an intensifier such as *very* or *extremely* disambiguates in favor of the exclamation.

(11) a. Martin knows how tall Susan is.
(= *Martin knows what her height is* or *Martin knows that she is notably tall*)
b. Martin knows how very tall Susan is.
(= *Martin knows that she is notably tall*, ≠ *Martin knows what her height is*)

(Not all clauses are ambiguous: for instance, embedded *whether*-questions have no exclamative reading, and exclamatives with the form *what a N*, such as the one in (10b), cannot be interpreted as questions even when embedded.) Embedded exclamatives, like questions, can also be expressed by determiner phrases: *Susan's remarkable height*, *the incredible fool Susan is*.

With this in mind, let us look at the predicates *think*, *appreciate*, *wonder*, *find out*, and *care*, all of which c-select for CPs. These predicates vary as to whether they s-select for (a) a proposition, (b) a question, or (c) an exclamative, and whether they c-select for (d) a determiner phrase expressing a question or exclamative; or (e) a null complement.

(12) a. John thinks that the time is 3 pm.
b. *John thinks what time it is.
c. *John thinks how incredibly late it is.
d. *John thinks the time.
e. *I think that the time is 3 pm, and John thinks too.

(13) a. John appreciates that this task was difficult.
b. *John appreciates who completed this task.
c. John appreciates how incredibly difficult this task was.
d. John appreciates the incredible difficulty of the task.
e. *I appreciate that this task is difficult, and John appreciates too.

(ii) a. The king ordered the traitor's execution. ("concealed command" OK)
b. *The king asked the traitor's execution. ("concealed command" ungrammatical)

Much remains to be said about the syntactic and semantic distribution of imperatives, and about the possible relation between imperatives and the categories discussed by Grimshaw, and the relation between embedded and matrix imperatives. The latter, for instance, cannot have the passive form seen in (i)—**The prisoner be executed!*—without an auxiliary—*May the prisoner be executed!* I will have nothing further to say about them in this dissertation. (I am grateful to Justin Fitzpatrick (p.c.) for the original observation.)

(14) a. *John wonders that the time is 3 pm.
b. John wonders what time it is.
c. *John wonders how incredibly late it is.
d. *John wonders the time/the incredible lateness of the hour.
e. *I wonder what time it is, and John wonders too.

(15) a. John found out that the time is 3 pm.
b. John found out what time it is.
c. John found out how incredibly late it is.
d. John found out the time/the incredible lateness of the hour.
e. I found out what time it is, and John found out too.

(16) a. John cares that the time is 3 pm.
b. John cares what time it is.
c. *John cares what an idiot James is.
d. *John cares the time.
e. I care what time it is, and John cares too.

The predicates in (12)-(16) have the following lexical specifications, where P, Q, and E represent propositional, interrogative, and exclamative meanings, and parentheses indicate that the argument is optional.

(17)

	c-selection	**s-selection**
think	[___ CP]	< ___ P>
appreciate	[___ CP, DP]	< ___ P, E>
wonder	[___ CP]	< ___ Q>
find out	[___ (CP, DP)]	< ___ P, Q, E>
care	[___ (CP)]	< ___ P, Q>

Note that some predicates take DP complements and some do not; some take their complements obligatorily and some optionally; some take propositions, some questions, some exclamations, in varying combinations. Looking in particular at *wonder* and *find out*, we see that both accept complements which denote questions, but while the latter allows both CPs (e.g. clausal questions) and DPs (e.g. concealed questions), the former allows only CPs (and thus does not allow concealed questions); in this manner, syntactic selection can distinguish between those predicates which allow CQs and those which do not.

The second part of Grimshaw's proposal is the *Autonomy Hypothesis*: c-selection and s-selection are specified independently. We saw before that the mapping between syntactic and semantic forms is not one-to-one, nor even many-to-one or one-to-many: items in the same syntactic category can have meanings belonging to different semantic categories, and meanings of the same semantic category can be represented by expressions of different syntactic types. That is, both CPs and DPs can express propositions, questions, or exclamations, and conversely, each of the semantic types can be expressed by a CP or DP.

We see in (17) that there are predicates such as *think* that accept proposition CPs as complements but not question CPs, and that there are predicates such as *wonder* that accept question CPs but not proposition CPs. Therefore, s-selection is not predictable from c-selection—in particular, the syntactic ability to take a CP complement does not entail having the ability to take a proposition-denoting complement, or the ability to take a question-denoting complement, or both. Thus, predicates cannot be lexically specified for syntactic complements without mention of semantic restrictions. By the same token, there are predicates such as *wonder* that accept CP questions but not DP questions, and thus c-selection is not predictable from s-selection: predicates also cannot be lexically specified for semantic complements with no syntactic restriction. Hence, the Autonomy Hypothesis: the lexicon needs both c-selection and s-selection, and the two must be specified independently.

How does the Autonomy Hypothesis relate to the PCQC given at the beginning of this chapter (among question-embedding predicates, propositions and CQs have the same distribution)? For Grimshaw, a predicate allows a CQ complement only if it c-selects for DPs *and* s-selects for Qs, as *find out* does in (17). In terms of Grimshaw's selections, the PCQC states that, among predicates that s-select for Q, predicates s-select for P if and only if they c-select for DP. If the PCQC holds, the Autonomy Hypothesis becomes much less likely. The former predicts that no predicate has the selectional specifications in (18),

(18)		**c-selection**	**s-selection**	
	a. ___?	[___ CP, DP]	< ___ Q>	(CQs but not propositions)
	b. ___?	[___ CP]	< ___ Q, P>	(propositions but not CQs)

whereas if c-selection and s-selection are independent, the lack of such specifications in the lexicon is a mere accidental fact.

In fact, the specifications in (18) are not unattested, a problematic fact for the PCQC. Recall the data given in the introduction for *know*, *ask*, *care*, and *wonder*. The sentence in (2) showed that all four allow clausal questions; in Grimshaw's terminology, they all c-select CP and s-select Q.

(2) Kim {knew/asked/cared/wondered} how late it was.

The different behaviors in (3) result from differences in c-selection for DP and s-selection for propositions. The table in (19) shows the full c-selection and s-selection facts.[4]

(3)				
	a.	Kim knew...	...the time.	...that it was after 5 pm.
	b.	Kim asked...	...the time.	*...that it was after 5 pm.
	c.	Kim cared...	*...the time.	...that it was after 5 pm.
	d.	Kim wondered...	*...the time.	*...that it was after 5 pm.

[4] That is, full with respect to P and Q. *Know* also happens to s-select for exclamatives; as I have little to say about the distribution of exclamatives and concealed exclamatives, I will omit them for the sake of clarity. Similarly, I omit c-selection for optionally null complements as an unnecessary complication.

(19)

	c-selection	s-selection	
know	[___ CP, DP]	< ___ Q, P>	
ask	[___ CP, DP]	< ___ Q>	≡ (18a)
care	[___ CP]	< ___ Q, P>	≡ (18b)
wonder	[___ CP]	< ___ Q>	

Know and *ask* can take CQ complements because they are marked [___ DP] and <___ Q>. These properties are independent of each other and of any other property, so being marked for both—i.e. taking CQs as complements—is an accidental, non-predictable fact about any given predicate.

Given the binary nature of selection (that is, a predicate either does or does not c-select for a certain syntactic form, and either does or does not s-select for a certain semantic form), the table in (19) shows all four possibilities for selecting or not selecting DP or P, among predicates that c-select for CP and s-select for Q. In theory, four independent binary options should correspond to sixteen possibilities. In practice there are only nine, because we are concerned only with predicates that embed some sort of sentential complement (i.e. predicates that s-select for at least one of P and Q) with some overt syntactic form (i.e. predicates that c-select for at least one of CP and DP).[5]

In addition to the four possible selection frameworks seen above, there are two with selection for CP but not Q, two with selection for Q but not CP, and one with selection for neither:

(20)

c-selection	s-selection
[___ CP, DP]	< ___ P>
[___ CP]	< ___ P>
[___ DP]	< ___ Q, P>
[___ DP]	< ___ Q>
[___ DP]	< ___ P>

The first two and the last of these need not concern us here, as predicates exhibiting these frameworks are not question-embedding predicates. (We will return briefly to such predicates in Chapter 5.)

The third and fourth possibilities (as well as the fifth) show frameworks in which the predicate would allow complements with question meanings, or proposition meanings, or both, but would not allow clausal questions/propositions. The Autonomy Hypothesis predicts the existence of such predicates, but they are in fact unattested. Grimshaw discusses this point herself (Grimshaw 1981), but let us move directly to Pesetsky's (1981) criticism of her solution and to his own counterproposal.

[5] In theory a predicate could exist that s-selects for neither P nor Q because it s-selects for other sentential meanings, such as E; as I am explicitly excluding exclamatives from consideration here, one of P or Q must be s-selected for. Similarly, a predicate might c-select for neither CP nor DP if the proposition or question takes the form of some other syntactic category, but such predicates are also outside the scope of the discussion here.

2.2.2. Pesetsky (1981): Case Theory

Case Theory (Pesetsky 1981) simplifies Grimshaw's system by eliminating c-selection, folding its work into the independent fact that predicates must be specified for Case. Consider the abridged paradigm in (21):

(21) a. John knew what the time was.
b. John knew the time.
c. John wondered what time it was.
d. * John wondered the time.

Both *know* and *wonder* s-select question complements and both c-select CPs; but only the former c-selects DP complements.

Selection for DP therefore seems to be a particular fact about a proposition/question embedding predicate, but what about selection for CP? In fact, other than a few rare counterexamples,[6] every predicate that s-selects for propositions c-selects for CPs. Grimshaw (1981) suggests that each semantic form has a "canonical structural realization", which is CP for propositions, interrogatives, and exclamatives. The grammar then has an additional principle that any predicate which s-selects for a semantic category must c-select for its canonical structural realization. This, Pesetsky observes, means that the grammar no longer needs c-selection to predict the distribution of CPs—but of course, as DP selection is still not predictable, eliminating c-selection requires another explanation of the distinction in (21), i.e. of the distribution of concealed questions (and concealed exclamatives and propositions).

Pesetsky proposes that Case Theory explains the distribution as an example of quirky case. In languages that show overt morphology for case, some predicates require objects with unusual case marking. Icelandic is an often-invoked example. As a default, predicates take objects with accusative case, and most predicates have this default. But not all: for instance, *bjarga* 'rescue' requires dative case on its object.

Extending this to the complementation above, we can say that predicates that don't take CQs exhibit quirky case: *know* sets no case requirement and thus appears with both CPs and DPs, but *wonder* sets a particular requirement on its object's case, namely Caselessness. (Pesetsky hypothesizes a [+∅-case] feature, analogous with the presumable [+Dative case] that *bjarga* requires of its object). Since DPs must have case and CPs need not, a predicate whose object must be [+∅-case] can take the latter as its object but not the former. This recasts Grimshaw's lexical specifications as follows.

(22)		**Case**	**s-selection**
	know		< ___ Q, P>
	ask		< ___ Q>
	care	[+∅-case]	< ___ Q, P>
	wonder	[+∅-case]	< ___ Q>

From Case Theory, it also immediately follows that adjectives (which do not assign Case) never allow DP complements regardless of their s-selection, and that prepositional phrases (which do

[6] Pesetsky mentions *approve of* and *pay attention to*, which he reduces to the fact that prepositions never accept propositional CP complements, though they can embed interrogative CPs.

not require Case) can be complements of any predicates, including adjectives. I will revisit this consequence in §2.3.2.1.

This theory eliminates one of Grimshaw's selectional requirements by reducing it to an element independently required by the grammar. However, specification for Case is, like c-selection, independent of s-selection. The fact that *know* allows DPs and *wonder* does not is still specified lexically for the predicates, and while it is now specified with Case instead of c-selection, Case Theory (at least as presented by Pesetsky) preserves the Autonomy Hypothesis: marking or not marking one's object for ∅-case is independent of selection for interrogative (or propositional) complements, neither one affecting the other.

2.2.3. Discussion

We have seen reasons to believe that a predicate's ability to embed CQs (or lack thereof) is, from the point of view of s-selection, accidental; it does not follow from semantic facts alone. The Autonomy Hypothesis explicitly states that allowing or disallowing question-denoting DPs as objects cannot be predicted from allowing question-denoting objects in general, whether it is c-selection or Case Theory that determines the possibility of DPs. Marking predicates like *wonder* and *care* with the quirky [+∅-case] feature is, by the very nature of quirky case, an arbitrary fact underivable from other features of the lexical entry.

Data in the next section will suggest the opposite: CQ-embedding, which Grimshaw and Pesetsky reduce to a syntactic fact, does indeed correlate with semantic facts beyond question-embedding, and therefore predicates never need to be specified as allowing or disallowing CQs. Before we look at that data, we should note some evidence that the ability to embed "concealed" forms—DPs with propositional or interrogative meanings—does not correlate with the ability to embed DPs *simpliciter*. There are two distinct ways in which a predicate may allow DPs and also allow semantic objects with meaning M, and yet not allow DPs with meaning M (i.e. "concealed M" DPs).

First, marking a predicate as requiring [+∅-case] for its object predicts that it cannot take any DP at all as its complement. However, it turns out that *wonder* (and other predicates, such as *inquire*) can embed DPs, though of course its s-selection requires these DPs to denote questions.[7]

---

[7] Oddly, while *wonder* can embed question-denoting DPs, it cannot embed any with the noun *question* itself:

(i) Kim asked who left, and Sandy asked *that question* as well.
(ii) *Kim wondered who left, and Sandy wondered *that question* as well.

On the other hand, proposition-embedding predicates cannot embed them either.

(iii) *Kim {knew/guessed/told us/...} who left, and Sandy {knew/guessed/told us/...} *that question* as well.

The fact that *ask a (certain) question* is fine whereas *wonder/know/guess/tell a (certain) question* is not remains deeply mysterious to me.

(At least, this judgment holds for most speakers. Heidi Harley (p.c.) reports that, while on jury duty, she saw a lawyer "asking a prospective juror if he thought his upcoming dissertation deadline would distract him unduly during the trial if he was selected as a juror....during the course of asking about this, the lawyer said: *I'm wondering this question from two directions.*" Harley, other informants, and I all find the italicized sentence quite strange; I have no idea whether an Arizona lawyer would also accept sentences like (iii).)

For instance, demonstratives and *the same thing* can denote questions when they take their meaning from an antecedent question.

(23) a. Kim wondered who left, and Sandy wondered *that* as well.
b. Kim wondered who left, and Sandy wondered *the same thing*.

Relative clause markers and interrogative pronouns, which are generally taken to have Case, also readily appear as the complement to *wonder*.

(24) a. John told Mary who left, *which* she had wondered for some time.
b. *What* Mary wondered was who had left.
c. *What* is Mary wondering now?

Of course, these are actual DPs complete with Case and not some sort of exceptionally Caseless objects: they cannot appear in genuinely Caseless positions. For instance, like other DPs and unlike CPs, they cannot be extraposed subjects.[8]

(25) a. It matters to Kim who left.
b. * It matters to Sandy the same thing. (cf. *The same thing matters to Sandy*)
c. * What does it matter to Kim? (cf. *What matters to Kim?*)

Therefore, it is reasonable to conclude that *wonder* really does c-select for, or assign Case to, DPs; and of course it allows question objects. Nevertheless, it does not allow concealed question objects: CQs are not among the question-denoting DPs it can embed.

Second, a predicate that allows concealed DPs ought to allow them for any meaning it s-selects for. Pesetsky argues for the existence of concealed propositions:

(26) a. I'll assume that he is intelligent.
b. I'll assume his intelligence. (= Pesetsky 1991, 6)

(27) a. I'll pretend that he is intelligent.
b. * I'll pretend his intelligence. (= Pesetsky 1991, 7)

Predicates that embed concealed propositions must select for propositional meanings and must not assign [+∅-case] to their complement: thus, *assume* assigns Case normally, whereas *pretend* assigns [+∅-case] to its complement. Both verbs s-select only for propositions, making them exactly analogous to *ask* and *wonder*, which s-select only for interrogatives.

We saw in the last section that *know* accepts concealed DP complements and therefore does not assign [+∅-case]. It s-selects for interrogatives and therefore it allows concealed questions. Because it also s-selects for propositions, it should also allow concealed propositions. However, it does not:

---

[8] (25c) has a reading idiomatic to relevance predicates, for which *what* means "why" or "what...for": *what do you care?* means *why do you care?* or *what do you care for?*, but *what did you leave?* does not mean *why did you leave?* or *what did you leave for?*. Similarly, we find *what does it matter to Kim who left?*. On this reading *what* is an adverb, not a DP, and therefore does not require Case. As a DP, it does require Case assignment, so that (25c) cannot elicit (25a) as a response.

(28) a. I know that he is intelligent.
b. *I know his intelligence.

Insofar as the DP in (28b) can be interpreted at all, it can be interpreted only as a concealed question: *I know how intelligent he is* or *I know what the level of his intelligence is*. So once again we have a predicate whose concealed-DP-embedding abilities are not a simple function of its abilities to embed DPs.[9]

Neither of these undesirable predictions is an argument against Case Theory itself, for which arguments exist independent of facts about CQs. Indeed, in the remainder of this chapter, we will come back to Case Theory to explain certain distributional facts. What the discussion in this section does indicate is the following. First, autonomous syntactic and semantic selection properties, however they may be described, cannot have the independence claimed in Grimshaw (1979). The distribution of CQs depends on either some semantic fact or some semantically-influenced syntactic selection. Second, marking predicates as assigning [+∅-case] does not by itself explain the distribution.

This brings us back to the Proposition/CQ Correlation. Recall that the correlation expresses a generalization on predicates which, in a theory that separates the ability to embed CQs from the ability to s-select for propositions, must be an accidental fact about the lexicon. If we re-examine the data surrounding the *know/ask/care/wonder* distinction that introduced this chapter and find the PCQC to be correct, we will have further evidence that the Autonomy Hypothesis and Case Theory are insufficient to explain the distribution of CQs.

2.3. A Second Approach: a Semantic Answer

Before going directly to the evidence for the PCQC, we should consider a previous attempt to correlate the distribution of CQs with other semantic attributes of question-embedding predicates. Dor (1992), taking Karttunen's classification of question-embedding predicates as a starting point (see the list in §1.3.1), observed that—certain exceptions aside—predicates in five of Karttunen's categories (knowledge retention, knowledge acquisition, communication, decision, and conjecture) accept CQs and predicates in three (opinion, inquisition, relevance) do not.[10]

---

[9] Because I will not discuss concealed propositions beyond this section, I am not certain that the theory proposed in the following chapters does not make the same prediction. If it does, my suspicion is that, just as I will argue that so-called "concealed questions" actually have the denotation of propositions, a "concealed proposition" denotes something other than an actual proposition, and that *assume*, but not *pretend* or *know*, has a meaning compatible with whatever it does denote. Turning this suspicion into a theory would require an examination of the distribution of concealed propositions, which would hopefully correlate with some other aspect of these verbs (as the distribution of CQs correlates to the distribution of propositions). This kind of move might be compatible with Case Theory, but exploring the adaptations necessary is well outside the scope of this dissertation.

[10] Dor, like Grimshaw, sets aside verbs with question subjects as outside the realm of lexical specification. Primarily this encompasses dependence verbs, though many of Karttunen's question-taking predicates (*be relevant*, *be important*, *be significant*) take questions as subjects or extraposed subjects with an expletive *it* (*Who left is relevant*; *It is relevant who left*).

The tradition in the literature of ignoring predicates which select question subjects will come back to haunt us later. Beck and Sharvit (2002) use verbs of dependency as crucial evidence for their theory, and anyone writing

The following table represents Dor's judgments on the eight categories:

(29) Dor's (approximate) judgments for predicates with CQ complements

a.	*retaining knowledge*	John {knew / recalled / remembered / forgot} the price of milk.
b.	*acquiring knowledge*	John {learned / noticed / found out / discovered} the price of milk.
c.	*communicating*	John {told / showed} me the price of milk.
		John {indicated / disclosed / revealed} the price of milk.
d.	*decision*	John {decided / determined / specified} the price of milk.
e.	*conjecture*	John {guessed / predicted / estimated} the price of milk.
f.	*opinion*	*John {was certain / was convinced} the price of milk.
g.	*inquisition*	John asked (me) the price of milk.
		*John {wondered / inquired} the price of milk.
h.	*relevance*	*John cared the price of milk.

The pattern in (29) suggests the existence of exactly the sort of semantically-based restriction on CQ distribution that the syntactic theories of the previous section cannot capture. Because we are treating Karttunen's categories as a descriptive tool of the metalanguage rather than lexical facts about words of English—that is, because predicates are not lexically marked as [+decision] or [+conjecture]—these judgments do not themselves represent a grammatical correlation between the ability to take a CQ complement and some other fact about a predicate. Both theories considered in this section offer some semantic fact which *is* present in, or predictable from, a predicate's lexical entry, and which correlates with Karttunen's categories in (roughly) the same way that CQ distribution does.

In §2.3.1, we will look at Dor's explanation for the correlation in (28), which links these judgments with the "epistemic commitment" of a predicate, and see that the generalization is not as clear-cut as he predicts. §2.3.2 will present the case for a new semantic explanation, namely that a correlation exists between embedding propositions and embedding concealed questions.

2.3.1. Dor (1992): Epistemic Commitment

Dor proposes that predicates can be distinguished by a variation on factivity more suited for questions: it is not the truth of the complement that matters, but its *epistemic commitment*: whether the subject knows the answer to the question complement. This is exemplified by the syllogism in (30).[11]

---

about question complementation can no longer ignore these predicates, which will turn out to cause a certain amount of trouble.

All the same, I'll join my predecessors in setting aside question subjects for the time being, though I do so for expository reasons and with the promise to return to them later.

[11] The first premise of the syllogism structure involves the embedded question *what X was*. Though identity questions are common paraphrases of CQs, Dor does not seem to intend the syllogism to require identity questions—his syllogisms use the question *where the meeting was to be held*—but instead apparently uses *what X was* and *X was Y* to stand in for any question and its true answer. The premises that appear below will also not strictly have the form *what X was*.

(30) John [PRED-ed] what X was.
X was Y.
⊢John knew that X was Y. (= Dor's (18))

If a predicate satisfies the syllogism in (30), it has *Positive Epistemic Commitment* (PEC), formally defined in the paper as "impl[ying]...that its cognitive subject *has* assigned the true value to the variable represented by a *wh*-phrase." The opposite property, *Negative Epistemic Commitment* (NEC), is defined analogously, with the syllogism in (31).

(31) John [PRED-ed] what X was.
X was Y.
⊢John did not know that X was Y. (= Dor's (26))

An NEC predicate is one that satisfies this syllogism and thus "implies...that its cognitive subject has *not* assigned the true value to the variable represented by a *wh*-phrase".

Dor claims that, broadly speaking, the predicates in the first five categories in Karttunen's classification are PEC predicates, while those in the others are NEC. Predicates in the first five categories embed both concealed questions and exclamations, while those in the last three embed neither. Dor therefore concludes that only PEC predicates take exclamatory complements, and only non-NEC predicates take concealed questions. The difference between the two sets is *ask*, which is non-NEC (because one can ask a question while knowing the answer—game show hosts do so often), but is also not PEC (because one can ask a question without knowing the answer). Not being PEC, it cannot embed exclamations, but not being NEC, it can embed concealed questions.

This theory is appealing in light of the conclusions of the previous section, as it describes the distribution of CQs with no reference to syntactic complementation (c-selection, Case) at all. Nevertheless, it has certain empirical gaps. For example, within the class of inquisitive predicates Dor groups *inquire* with *wonder* (and separately from *ask*) in the class of NEC predicates on the basis of the following syllogism.

(32) John inquired where the meeting was to be held.
The meeting was to be held in the office.
⊢John did not know that the meeting was to be held in the office.

But for many speakers this syllogism is not valid; *inquire* does not differ from *ask* at all in this respect. That is to say, if John already knows the answer and is stating a question (for confirmation, say, or to make the answer public), the first sentence in (32) is as acceptable as *John asked where the meeting was to be held.* Nevertheless, even for those speakers who find (32) invalid (i.e. for those speakers for whom *inquire* is a non-NEC predicate), *inquire* does not take concealed questions.[12]

[12] My own intuition that (32) is invalid is not strong, and some readers have questioned the judgment. Nevertheless, every informant I asked accepted *inquire* in a context in which the inquirer already knew the answer to the question and wanted to make the answer public. Searching with Google and with Amazon.com's contents-searching feature turns up numerous examples from published books and articles, such as:

(i) During dinner Anna Mihalovna talked of the rumours from the war, of dear Nikolay, **inquired** twice when his last letter had been received, **though she knew perfectly well**, and observed that they might well be

Conjecture verbs do not neatly categorize as non-NEC predicates. Dor considers *guess* a PEC-predicate, which would mean that *John guessed where the meeting was to be held* entails that he knew the location. Though one meaning of *guess* is *guess correctly*, it seems more likely as a scenario that, if John guessed where the meeting was to be held, he did not actually know.[13] This is even clearer with *estimate* and *predict*.

(33) John estimated how tall the building was.
<u>The building was 45 stories tall.</u>
$\vdash^{?}$John knew that the building was 45 stories tall.
$\vdash$John did not know that the building was 45 stories tall.

(34) John predicted who the winner of the 2004 World Series would be.
<u>The Red Sox were the winners of the 2004 World Series.</u>
$\vdash^{?}$John knew that the Red Sox would be the winners of the 2004 World Series.
$\vdash$John did not know that the Red Sox would be the winners of the 2004 World Series.

---

getting a letter from him to-day. (Leo Tolstoy, *War and Peace*, translation at Bibliomania (http://www.bibliomania.com/); also used in Rosemary Edmond's translation)

(ii) "Did you hear that?" [Threepio] **inquired rhetorically** of his patient companion, referring to the throbbing sound. (George Lucas, *Star Wars: A New Hope*)

(iii) When it came time to pay the bill, I **inquired** if they took credit cards, **but I was sure I knew the answer already**. ("Lebanese specialties, with character", May 21, 2003, *The [New Hampshire] Union Leader*: http://www.theunionleader.com/Gourmet_show.html?article=21479&archive=1)

Of course, some speakers *do* accept the syllogism in (32). Danny Fox (p.c.) observed the following, which may explain the fuzziness of the judgments: asking and inquiring, unlike the actions described by many other predicates (*know*, *remember*, *care*, *wonder*), are public acts, and thus rely not only on whether the subject knows the answer but on whether the subject seems to know it. A person may ask something whether or not it's known that they know the answer (again, think of game show hosts or professors giving tests), but inquiring something suggests that they don't know the answer. Consequently, a person may inquire something she already knows the answer to, even something that it's known that she knows the answer to (as with Anna Mihalovna, who inquired twice), but her inquiry is pragmatically disingenuous—it requires a pretense of not knowing the answer and thereby violates a social convention. Nevertheless, one *can* "inquire" as long as one is willing to flout the pragmatic felicity; and on the purely semantic grounds on which Dor's theory makes predictions, *inquire* is non-NEC.

Complicating matters further, *inquire* historically did take concealed questions as objects. The OED separates the question-taking meaning of *inquire* into the usages "with interrogative clause as object" and "with simple object". The latter, it notes, is "now less usual", but the citations indicate that *inquire* used to appear with concealed questions: *You must enquire your way* (Shakespeare, *Coriolanus*); *The wily mother...Wi' heart-struck, anxious care, inquires his name* (Burns, "Cotter's Saturday Night"); and many others. This may seem to cause trouble for the PCQC—assuming that Shakespeare and Burns would have rejected *inquire* with a proposition, at any rate. My suspicion is that *inquire* used to behave the way *ask* currently does; see §5.3.3 for discussion.

In the end, *inquire* is at the very least problematic for Dor. The details of pragmatics, synchronic variation, and diachronic change, I must leave to future researchers.

[13] Dor's actual formulation of Positive/Negative Epistemic Commitment requires that the predicate only commit the subject to (not) knowing the answer to the complement in *some* sense of the predicate. This is an unusual sort of requirement, insofar as it would allow an NEC use of a verb like *guess* to embed concealed questions on the strength of the existence of other uses. Even so, it's not clear that any sense of a conjecture verb implies that the subject knows the answer to the embedded question.

In both cases, John may have been right (i.e., he may have estimated that the building was 45 stories tall, or he may have predicted that the Red Sox would win the World Series) and even have been confident that he was right, but in neither case did he know. Thus *estimate* and *predict* do not seem to be PEC predicates at all, and in fact appear to be NEC predicates. Nevertheless, both take CQs (*John estimated the height of the building*; *John predicted the winner of the 2004 World Series*).[14]

With these predicates, we already have enough counterexamples to Dor's proposed correlation for us to start exploring other approaches. Before we continue, however, let us take a moment to note a handful of other predicates, undiscussed by Dor, for which the theory of epistemic commitment makes the wrong predictions. In fact, we will see in the next section that they also run counter to the correlation to be proposed between CQ-embedding and proposition-embedding, but that gives us even more reason to want them on the table in advance.[15]

First among these predicates is *care*, which Dor uses to exemplify the non-CQ-embedding nature of relevance predicates but leaves out of the PEC/NEC discussion. The NEC syllogism does not hold with *care* (i.e. (35) is invalid), so *care* does not have a negative epistemic commitment.

---

[14] Verbs of conjecture have a complicated sort of factivity. With propositional clauses, none of them are factive:

(i) John guessed that I was 20 years old, but he was wrong.
John estimated that the building was 50 stories tall, but he was wrong.
John predicted that the Yankees would win the 2004 World Series, but he was wrong.

With question clauses, the verbs seem more factive...

(ii) ??John guessed how old I was, but he was wrong.
?John estimated how tall the building was, but he was wrong.
??John predicted who would win the 2004 World Series, but he was wrong.

...and with concealed questions, *guess* and *predict* seem outright factive.

(iii) #John guessed my age, but he was wrong.
?John estimated the height of the building, but he was wrong.
#John predicted the winner of the 2004 World Series, but he was wrong.

Of course, *tell* behaves similarly—non-factive with propositions, factive with questions and concealed questions.

Note that, in any case, the difference in the factivity of these verbs with questions and concealed questions cannot salvage Dor's theory. Though *John guessed my age* and *I am 30 years old* may together entail *John guessed that I am 30 years old*, i.e. that his guess was correct, the verb—as explained in the main text—still carries no positive epistemic commitment: correct or not, John didn't *know* that I am 30 years old. (And, of course, to use factivity by itself to describe the ability to embed concealed questions is to beg the question for predicates like *wonder*, as it is only for proposition-embedding predicates that factivity is a sensible notion.)

[15] As it happens, the upcoming Case-based explanation for why they are counterexamples to the PCQC can also be used to explain why they are counterexamples to Dor's PEC/NEC approach. But while it is true that one could supplement epistemic commitment with Case Theory and thereby explain *inform* and *investigate*, *be certain* would become a new problem: while still NEC, it will be able to embed CQs.

(35) John cared where the meeting was to be held.
The meeting was to be held in the office.
⊬John did not know that the meeting was to be held in the office.

Nevertheless, as we saw earlier and as Dor observes, *care* does not take CQs (**John cared the location of the meeting*).

Moreover, a few predicates differ from those used to exemplify their categories. *Inform*, like *tell* and other verbs of communication, has a positive epistemic commitment: like *tell*, question-embedding *inform* is factive, and thus to inform someone what X is one must know the answer to the embedded question. However, *inform* contrasts with *tell* in that it does not allow CQs.

(36) a. John told us the price of milk.
b. * John informed us the price of milk.

Conversely, while predicates of inquisition generally do not allow CQs, there are a few predicates in the category which, while also NEC predicates, seem better with CQs than *wonder* does. For example, *investigate* is at least arguably NEC, as one cannot investigate something one already knows the answer to, but *investigate* + CQ seems better than does *wonder*.[16]

(37) a. * John wondered the price of milk.
b. ? John investigated the price of milk.

With all of these cases—*care*, *inform*, *investigate*—Dor's classification seems at best incomplete.[17]

Dor's observation that CQ distribution is sensitive to some semantic property of predicates is sound, but his proposal that this property is epistemic commitment contains too many empirical gaps to be correct. Let us now move on to evidence for a new proposal.

---

[16] Though compare footnote 12: it might be semantically possible, and merely pragmatically disingenuous, to "investigate" something one already knows the answer to. Hence "arguably" NEC.

[17] Danny Fox (p.c.) observes that, because of the tenses in the syllogisms, *forget* also gets misclassified as NEC. *Forget*, as a verb of retaining knowledge, should be analogous to *know* and *remember*, both of which are PEC predicates. However, *John forgot where the meeting was to be held* entails that, at the time of his forgetting, he didn't know that the meeting was to be held in the office, and not that he did know.

John's forgetting, on the other hand, *does* entail that he knew where the meeting was to be held at some previous point (i.e. *John had known that the meeting was to be held in the office*). We could change the conclusion in the PEC schema in (30) to read *John knew or had known that X was Y*. But making the analogous change to the NEC schema, so that its conclusion reads *It is not the case that John knew or had known that X was Y*, i.e. *John did not know and had not known that X was Y*, results in no predicates being NEC: John might wonder where the meeting was to be held even if he had known at some earlier point, but forgotten in the meantime, that it was to be held in the office.

It might still be the case that a relatively minor alteration to Dor's theory will repair this problem, e.g. allowing a certain flexibility in the tense of the syllogism, just as a certain flexibility in tense is necessary for the identity question paraphrases of CQs (see footnote 7 in chapter 1). For that reason, I have consigned this discussion to a footnote; I am not certain that *forget* is a strong argument against Dor's theory, but it does bear mentioning as a concern if not an actual challenge.

2.3.2. The Proposition/Concealed Question Correlation

The initial observation that propositions and CQs seem to have unrelated distributions was based on the four predicates *know*, *ask*, *care*, and *wonder*, each of which exemplified a different possibility for CQ-embedding and proposition-embedding. Let us now give these possibilities a more careful examining by turning, like Dor, to Karttunen's predicates. Dor provided judgments for the ability to embed CQs; now let us see whether they can embed propositions.

(38) Judgments for predicates with propositional complements

a.	*retaining knowledge*	John {knew / recalled / remembered / forgot} that the price of milk was $1.99/gallon.
b.	*acquiring knowledge*	John {learned / noticed / found out / discovered} that....
c.	*communicating*	John {told / showed} me that.... John {indicated / disclosed / revealed} that....
d.	*decision*	John {decided / determined / specified} that...
e.	*conjecture*	John {guessed / predicted / estimated} that...
f.	*opinion*	John {was certain / was convinced} that...
g.	*inquisition*	*John {asked / wondered / inquired} that....
h.	*relevance*	John cared that....

Combining this with Dor's judgments in (29), we see the following correlation:

(39) Comparison of CQ embedding and proposition embedding

	a. *know*	b. *learn*	c. *tell*	d. *decide*	e. *predict*	f. ***be certain***	g. *wonder*	h. ***care***
CQ	✓	✓	✓	✓	✓	*	*	*
Prop.	✓	✓	✓	✓	✓	✓	*	✓
			[***inform***]				[***ask***] [***investigate***]	

For the most part it seems to be the case that proposition-embedding predicates are CQ-embedding predicates and vice versa. The classes of opinion and relevance predicates are exceptions; and *ask* is an exception within its category, as are *inform* and *investigate*, as we saw at the end of the previous section. If these various exceptions can be explained—and we will see immediately how three of the five can—then we postulate with some confidence the Proposition/Concealed Question Correlation first given at the beginning of this chapter:

(40) **The Proposition/Concealed Question Correlation (PCQC)** (approximate version)
In argument positions that allow questions, propositions and concealed questions have the same distribution.

The PCQC is not an explanation; it is only an observation about the data. It therefore suggests a next step, in two parts: the correlation should follow from other facts, and the way in which it follows should explain the counterexamples.

An explanation of *ask* and *care* must wait until Chapter 5, after we have seen how to derive the correlation from the denotations of CQs. In the remainder of this chapter, we can justify postulating the observed correlation by explaining other counterexamples. We will use machinery already available—Case Theory, and the observation that CQs must have identity meanings—to explain the apparent fact that opinion predicates allow propositional complements but not CQs. We will also examine two of the predicates introduced at the end of the previous section, *inform* and *investigate*. (Note that *inquire*, raised as a challenge to Dor's theory, is unproblematic here: it allows neither propositions nor CQs. Similarly, the conjecture verbs that caused trouble for Dor follow the PCQC.)

2.3.2.1. An explanation of be certain

Dor judged *be certain* and other predicates of opinion as non-CQ-embedding on the basis of sentences like (29f), repeated here.

(29f) *John {was certain / was convinced} the price of milk.

Certainly this sentence is ungrammatical. However, we need neither epistemic commitment nor the PCQC to see why: its ungrammaticality is a direct consequence of the inability of an adjective to assign the necessary Case to a DP complement. CPs, both propositional and interrogative, are unproblematic because they do not require Case.

We could at this point dismiss adjectives of opinion as a counterexample to the PCQC by simply excluding them from consideration on Case-based grounds, but there is good reason not to do so. A deeper exploration of *be certain* and other adjectives can actually support the generalization if it shows that, in the right circumstances, they do allow CQs as well as propositions.

Recall from §2.2.2 that Pesetsky (1991) not only uses Case to rule out CQs as complements for question-embedding adjectives, but also observes the consequence that, as prepositional phrases can appear in Caseless positions, non-Case-assigning words like adjectives and the verb *care* can take PPs as complements.

(41) a. John was certain *(about) the time. (cf. Pesetsky 1991, 34b/35)
b. John was convinced *(about) the time.
c. John cares *(about) the time. (= Pesetsky 1991, 33a)

We might want to claim that the acceptability of *about* + *CQ* in these argument positions, positions that allows propositions, provides support for the PCQC. Unfortunately, *inquire* and *wonder* also allow PP complements.

(42) a. Mary inquired *(about) the murderer of Caesar.
b. Bill wondered *(about) John's whereabouts. (= Pesetsky 1991, 33b-c)

Using the data in (41) to resolve opinion predicates and *care* as counterexamples to the PCQC would force us to consider *wonder*, previously a core motivating case to posit the correlation at all, to be a new counterexample. Additionally, this is beginning to seem like a step backwards for a semantic explanation: not only did we reject [+∅-case] as an explanation, but the Case-based explanation for *care* and *wonder* requires the kind of predicate-by-predicate stipulation that a semantic explanation seeks to minimize.

Using *about* to make these predicates compatible with CQs does not help the correlation. But this is not the result of using a preposition, but of using this particular preposition. Pesetsky himself makes the crucial observation, contra his 1981 claim,

> ...that *about* is [not] a "dummy" preposition like *of* which makes no semantic contribution. As correctly pointed out by Abney (1985), *about* does make a contribution. Thus *John asked about the time* need not be a request to name a specific time of day (e.g. ten o'clock), but may be a general request for information concerning some particular time of day (e.g. why ten o'clock and not noon was chosen for some event). (Pesetsky 1991, footnote 6)

That is to say, the DP complement of *about* in *John asked about the time* no longer has the strict identity-question or identity-proposition meaning characteristic of CQs, like the DP complement in *John asked the time* has. The same observation holds for *inquire about*, *wonder about*, *be certain about*, and *be convinced about*. The DPs do not necessarily denote identity questions—indeed, they seem to denote actual individuals, and the PP headed by *about* can take on the meaning of almost any question about the individual. As further evidence that *about* is not merely connecting the predicate to a concealed question complement, note that DPs that cannot be CQs can nevertheless serve as the object of *about* in these constructions:

(43) a. Bill wondered about Rome.
b. John was certain about the semanticist at USDNH.

Since *Rome* and *the semanticist at USNDH* cannot be CQs, *about* is doing more than licensing CQs in a position that ordinarily does not allow them.

But while it is true that *about* is not a dummy preposition, we do have a preposition which is used as a Case marker and "makes no semantic contribution": *of*. Just as *of* is used to mark Case in nominalization and certain gerunds (*Caesar's destruction **of** the city, John's eating **of** the cake*), we can use it with *be certain*:

(44) a. Sam is certain about the time of the meeting.
b. Sam is certain of the time of the meeting.
c. * Sam is certain {by/at/to/with/from...} the time of the meeting.

Other than *about DP*, which can denote a question due to the semantic contribution of *about*, no other preposition can head a PP complement to *be certain*. *Of* makes no more semantic contribution in (44b) than it does when introducing the object of a nominalized or gerundive verb. So in contrast to the relatively unconstrained meaning of (44a), (44b) cannot mean that Sam is certain of any fact about the time of the meeting *except for its identity*. In other words, when it is the complement of *certain*, *of DP* has exactly the meaning of a CQ, which suggests that the DP is a CQ and the preposition is exactly what *about* cannot be: a semantically empty preposition inserted for Case requirements.

The same facts hold for other adjectives that take questions as complements and for other phrases such as *have an idea* that do not assign Case directly; while verbs do not generally allow Case-marking *of*, they may select particular prepositions.

(45) a. Sam is aware (*of) the price of milk.
b. Sam has an idea (*of) the price of milk.
c. Sam and Jesse agreed (*on) the price of milk.

As with *certain*, all of these would also be grammatical with *about* (in which case the DP would not be not a CQ), and would not be grammatical with any other preposition, and have only an identity-question denotation for *of* + the DP. No such empty preposition exists for, say, *wonder* or *inquire*.

(46) a. * Sam wonders {of/on/to...} the price of milk.
b. * Sam inquired {of/on/to...} the price of milk.

(In contrast, see the next section for another verb which does use *of* as a Case marker.)

In short, we need not simply dismiss adjectives like *be certain* as irrelevant for Case reasons. Instead, once standard Case requirements are met—"standard" in the sense that an adjective's inability to assign Case is a general and predictable fact and not the same kind of quirky case needed to rule out *wonder* and *care*—predicates of opinion accept both propositional and CQ complements. In this way they actually support the generalization in the PCQC.

2.3.2.2. An explanation of inform

We can find a similar, albeit more complex, Case-based explanation for *inform*. *Inform* (and its near-synonym *notify*, though not other communication predicates such as *tell*) embeds propositions but not concealed questions:

(47) a. Kim informed Sandy when the meeting would take place.
b. Kim informed Sandy that the meeting was at 3 pm.
c. * Kim informed Sandy the time of the meeting.

But on closer inspection, *inform* does not embed questions quite as freely as other predicates. There is nothing exceptional about the embedded questions *who left* or *what you find out*, and *tell* embeds either without anomaly; yet *inform* cannot.

(48) a. John told me who left.
b. * John informed me who left.
c. Keep telling Sandy what you find out.
d. * Keep informing Sandy what you find out.

In particular, there seems to be a specific restriction on *who-* and *what-*questions as complements to *inform*, in contrast to *when-*, *where-*, or *why-*questions. One might suspect that some difference in the semantics is responsible, but note that the grammatical (47a) is essentially synonymous with the ungrammatical **Kim informed Sandy what the time of the meeting was.*

Let us hypothesize that *inform* has an odd syntactic selectional restriction against embedding *who-* or *what-*questions. This might extend to explain its resistance to concealed questions: even if we take CQs to have propositional meanings, they are closer to *who-* or *what-*questions than *where-* or *why-*questions Recall from §1.2.2 that, for instance, *the capital of Vermont* specifically cannot have the meaning *where the capital of Vermont is.*

What makes this especially seem like a syntactic selectional restriction is that these disallowed question complements improve with the addition of the Case-marking preposition *of*. And like *be certain*—but unlike other verbs like *wonder* and *care*—the verb *inform* allows CQs with *of*.

(49) a. John informed me of who left.
     b. Keep informing Sandy of what you find out.
     c. Kim informed Sandy of the time of the meeting.

Of course, *inform* is a verb and not an adjective, so this fact about Case assignment cannot be reduced to a more general restriction as it could with *be certain*. That would make *inform* with a CQ a genuine instance of quirky case assignment, with independent motivation from the way it embeds clausal questions. This dissertation cannot resolve the mysterious details of *inform*'s Case requirements, but these details provide an explanation of its apparent nature as a counterexample to the PCQC.[18]

2.3.2.3. An explanation of investigate

Earlier, I marked *investigate* as questionable with a CQ rather than ungrammatical. Certainly the sentence in (50) is not as bad as similar sentences with *wonder* or *care*.

(50) ?John investigated the price of milk. (= 37b)

Other predicates of inquisition, e.g. *be interested in*, also seem to allow CQs.

But recall once again the observation that CQs necessarily have identity meanings—that is, that they can be paraphrased by identity questions (or, as we will see later, identity propositions). With *know*, *learn*, *tell*, and so forth, DP complements denote exactly that: *John knows the price of milk* means *John knows what the price of milk is* (or, if the price of milk is $1.99/gallon, *John knows that the price of milk is $1.99/gallon*). The same is not true for *investigate* and *be interested in*: while (50) can mean *John investigated what the price of milk was*, the sentence can also describe a situation in which John investigated why the price of milk was so high, or whose job it was to determine the price of milk, and so forth. The DP complement of *investigate*, like that of *wonder/care/know about* above, and *discuss* and *comment on* in §1.2.2, is not really a concealed question.

2.4. Summary

Now that many of the apparent counterexamples to the generalization have been explained, we can put forth with more confidence a slightly revised version of the PCQC. In light of the discussion in the previous section, the generalization must make allowances for Case assignment, both predictable (as with adjectives) and quirky (as with *inform*).

[18] I first discussed *inform* as a problematic predicate for Dor because it does not seem to embed CQs. One could counter this problem using the argument in this subsection: *inform* actually does embed CQs, once you include the preposition *of*. But the immediate consequence of this argument is that the NEC *be certain*, once you include *of*, also embeds CQs; using Case explains *inform* only at the cost of no longer explaining opinion predicates.

(51) Comparison of CQ embedding and proposition embedding (revised)

	a. *know*	b. *learn*	c. *tell*	d. *decide*	e. *predict*	f. *be certain*	g. *wonder*	g′. ***ask***	h. ***care***
CQ	✓	✓	✓	✓	✓	✓	*	✓	*
Prop.	✓	✓	✓	✓	✓	✓	*	*	✓

(52) **The Proposition/Concealed Question Correlation (PCQC)** (revised version)
In Case-assigning argument positions that allow questions, propositions and concealed questions have the same distribution.

When the verbs under consideration were *know*, *wonder*, *ask*, and *care*, the latter two seemed to indicate the absence of a correlation. Now they seem like exceptions to what is otherwise a solid correlation in the distribution of CQs and (clausal) propositions.

What does this tell us about the meaning of CQs themselves? We began the chapter with the possibility that CQs denote questions, coupled with the observation that, with clausal and concealed questions having the same semantic type but different syntactic categories, a theory of syntactic argument selection would be necessary to explain their distribution. However, an approach that reduces CQ-embedding to c-selection or quirky case, or any other syntactic fact independent of s-selection for propositions, cannot capture the PCQC; the correlation between embedding propositions and embedding CQs becomes an accidental fact about the lexicon. These theories would need an additional stipulation in the grammar about the relation between the syntax and the semantics, which runs counter to the Autonomy Hypothesis.

Therefore, we must consider other possibilities for CQ meanings, meanings sensitive to the semantic properties of question-embedding predicates. The next chapter presents the primary current theory of CQ meaning, in which CQs denote individual concepts, and shows that—whether or not it captures the PCQC—it makes incorrect predictions about which DPs can be CQs. In Chapter 4, I propose a new theory in which CQs denote propositions, which has the PCQC as an immediate consequence.

CHAPTER 3 - WHY CONCEALED QUESTIONS DO NOT DENOTE INDIVIDUAL CONCEPTS

In the last chapter, we saw that treating concealed questions as denoting questions led to an inability to explain their distribution. Though this treatment allowed a simplification in the s-selection of CQ-embedding predicates, which universally accept CP questions as complements and thus need no additional semantic marking to accept DP questions, it simultaneously forced a complication in the c-selection or Case assignment, as well as blocking any easy connection between the ability to embed CQs with other semantic facts.

In this chapter, we will consider (and ultimately reject) another possible denotation for CQs, namely that of *individual concepts* (ICs), functions from indices to individuals. We begin in §3.1 with a discussion of why assigning individual denotations to CQs is insufficient. §3.2 then introduces the individual concept, followed by the theory of Romero (2005), in which CQs have IC denotations. §3.3 suggests, as a challenge to the theory, that a wide variety of DPs have IC denotations, and not all of them can be CQs; and §3.4 introduces Lasersohn (2005), who offers a new view of individual concepts, which makes them seem even less well-suited to be CQ denotations.

3.1. Why Concealed Questions Do Not Denote Individuals

Before we venture into individual concepts, let us consider a simpler possibility, namely that CQs denote individuals. After all, DPs (or at least definite descriptions) need to have individual denotations available for independent reasons, and giving CQs denotations of type *e* instead of type $\langle s, e \rangle$ potentially allows simpler meanings, with one less variable to bind or otherwise saturate. It will turn out that neither of these is an advantage: empirical evidence suggests that first, while DPs can denote individuals, they do not when used as CQs, and second, having an intensional object—i.e., having a world variable—is advantageous, and indeed necessary.

But as neither of these conclusions is immediately obvious, we will begin by seeing what a theory treating CQs as individual-denoting expressions would look like. As mentioned above, any definite description, whether it can act as a CQ or not and whatever other denotations it might have, can denote an individual of type *e*.[1]

(1) a. Sam painted her bedroom *the color of her hair.*
b. Leslie visited *the capital of Vermont.*
c. Kim met *the semanticist who teaches at USNDH.*

In none of these sentences is the DP interpreted as a CQ. So unlike the theory that CQs denote questions, this theory requires no additional mechanism to derive CQ denotations. The extra work in this case lies in postulating an extra meaning for verbs like *know*, but not for those like *wonder*, in which the first argument is an individual, rather than a proposition or question.

Heim (1979) somewhat cautiously advances a theory of this kind. She suggests that a CQ-embedding predicate is context-dependent and has a built-in variable $P_{\langle s, \langle se, t \rangle \rangle}$ whose value is

[1] Or the equivalent, if for instance one generalizes to the worst case and has all DPs denote $\langle et, t \rangle$ objects.

determined pragmatically. For example, the CQ-embedding sense of *know*, KNOW(*P*), corresponds roughly to "knows as *P*"; in a context where *P* is the property of being the capital of Italy, *know x* has the sense "know *x* as the capital of Italy". The invalidity of the syllogism in (2) with CQ-embedding *know*, which we saw in §1.2.1, relies on using two different *P*s in the first premise and the conclusion.

(2) John knows_{CQ} the capital of Italy.
The capital of Italy is the largest town in Italy.
$\nvdash$ John knows_{CQ} the largest town in Italy.

In both the premise and the conclusion, the object DPs denote *Rome*, which is both the capital of Italy and its largest town. In the first premise, the contextual variable *P* is the property of being the capital of Italy, so that the sentence means "John knows Rome [≡ 'the capital of Italy'] as the capital of Italy". The conclusion, using a different *P*, means "John knows Rome [≡ 'the largest town in Italy'] as the largest city in Italy."

Romero (2005) provides a simple argument against Heim's theory: because KNOW(*P*) is a relation between two individuals, any individual-denoting argument should provide all the information the predicate needs. For example, Heim's pragmatic theory would allow *John knows Rome* to have the CQ-like meaning "John knows Rome as the capital of Italy" in the proper context, but the sentence has only the "be familiar with" sense of *know*.[2] (For another argument from Romero, one that centers on an ambiguity to be discussed in §3.2.2, see footnote 13.) This argument, *mutatis mutandis*, will hold against any theory in which the CQ denotes an individual. In this way, it turns out that having the world variable in an $\langle s, e\rangle$ denotation will prove useful in distinguishing expressions which, though accidentally coextensional, have different intensions.

So using individual denotations for CQs involves an unavoidable lack of information. In addition, empirical evidence demonstrates that DPs used as CQs behave differently than DPs used to denote individuals. For example, while both CQs and individual-denoting DPs can be the objects in right-node-raising sentences, a single DP object cannot denote a CQ for one verb and an individual for the other (similar facts hold with VP conjunction when both verbs are passivized).

[2] A possible context, suggested by Kai von Fintel, p.c.:

[I asked John the capital of Italy and Peter the capital of Germany.]
(i) John knew Rome but Peter didn't know Berlin.

The sentence in (i) may not sound terrible in this context, though on an informal survey of English speakers it's not particularly good. Of course, (ii) sounds fairly robustly bad, even if the conversants are trivia buffs who know offhand the birthplaces of various famous people:

(ii) #John knew the birthplace of Sophia Loren but Peter didn't know the birthplace of Elke Sommer.

Taking "the birthplace of Sophia Loren" to simply denote Rome and "the birthplace of Elke Sommer" to denote Berlin, this ought to be just as good as (i) in the same context. I suspect that, to whatever extent (i) sounds good, it's a fact about metonymy with proper names and not about the pragmatic abilities of CQ-embedding *know*.

(3) a. Sam told me, and Kim learned independently, the capital of Vermont.
b. Sam has seen pictures of, and Kim has actually visited, the capital of Vermont.
c. # Sam told me, and Kim has actually visited, the capital of Vermont.
d. # Kim visited, and Sam told me, the capital of Vermont.

Compare the latter two sentences to *Sam told me the capital of Vermont, and Kim has visited the capital of Vermont* (or vice versa). If both *tell* and *visit* denote $\langle e, et\rangle$ predicates that compose with the individual "Montpelier", with the work of getting a CQ meaning done by the CQ-embedding verb, we would expect the latter two sentences to be as felicitous as the first two.

Additionally, while a gendered pronoun is used as an anaphor for a DP when it denotes an individual, a genderless pronoun is used when its antecedent DP is a CQ.

(4) a. Kim introduced Sam to [the governor of California]$_{\text{individual}}$, so now Sam knows {him/#it} too.
b. Kim told Sam [the governor of California]$_{\text{CQ}}$, so now Sam knows {it/#him} too.

If *the governor of California*$_{\text{CQ}}$ had the (gendered) individual "Arnold Schwarzenegger" as its referent, we would expect a pronoun with the CQ as its antecedent to agree with it in gender. Nevertheless, *it* is used as a pronoun for a CQ instead of *him*.[3] Similarly, while *it* can stand in for a CQ, it cannot do so when its antecedent is an individual, even a genderless individual:

(5) # Kim visited [the capital of Vermont]$_{\text{individual}}$, and Sam told it$_{\text{CQ}}$ to me.

Again, compare this to, say, *...and Sam showed me pictures of it*, where the pronoun does denote an individual and is acceptable. *It* can denote an individual, but that individual denotation cannot be a CQ.[4]

In short, a CQ must denote something other than an individual. We will now consider the possibility that it denotes an individual concept.

---

[3] Romero (2005) also observes this in §4.1, though in a different context.

[4] An apparent counterexample to the distinction in reference between individuals and CQs appears in (i), in which it seems that *it*, denoting an individual, has a CQ as its antecedent:

(i) Sam told me the capital of Vermont, and Kim has actually visited it.

However, pronouns are notoriously good at picking out any salient individual from discourse, not just those named overtly. A similar effect can be seen with a full question.

(ii) Susan told me who governs California, and added that she met him once.

No constituent in the clause *Susan told me who governs California* actually denotes the referent of *him*, namely "Arnold Schwarzenegger", but he is salient enough to serve as an antecedent. Since the individual "Montpelier" is salient in *Sam told me the capital of Vermont*, the acceptability of (i) does not force us to assume that any constituent such as *the capital of Vermont* actually denotes "Montpelier", and thus is not especially worrisome.

3.2. Concealed Questions as Individual Concepts

In the previous section, we saw that a type *e* denotation, though available for some DP uses, does not suffice for a DP used as a concealed question. This section considers another denotation available to at least some DPs: *individual concepts* (ICs), functions which map a world/time index to an individual at that index and which have the semantic type $\langle s, e\rangle$.

We can use DP *the president of the United States* as an example. In addition to denoting the individual "George Walker Bush" at the time of this writing, it can also denote the function from world/time indices to the individual who, at that time and in that world, is the president. If we focus on times and hold the world constant, that function will be:

$$\begin{bmatrix} \texttt{1789} & \rightarrow & \text{George Washington} \\ & \vdots & \\ \texttt{1796} & \rightarrow & \text{George Washington} \\ \texttt{1797} & \rightarrow & \text{John Adams} \\ & \vdots & \\ \texttt{1861} & \rightarrow & \text{Abraham Lincoln} \\ & \vdots & \\ \texttt{2005} & \rightarrow & \text{George W. Bush} \\ & \vdots & \end{bmatrix}$$

i.e. the function that, for any time, returns the president at that time. (The function is undefined for times before 1789, when *the president of the United States* did not denote any individual; for times after the present, the function is defined, though we do not of course know in 2005 what the value of the function will be in 2009.) More accurately, because the argument of the function is a world/time index, we have:

$$\begin{bmatrix} & & \vdots & \\ \texttt{2005;} & w_0 & \rightarrow & \text{George W. Bush} \\ \texttt{2005;} & w_1 & \rightarrow & \text{Dick Cheney} \\ \texttt{2005;} & w_2 & \rightarrow & \text{John Kerry} \\ \texttt{2005;} & w_3 & \rightarrow & \text{Al Gore} \\ \texttt{2005;} & w_4 & \rightarrow & \text{John McCain} \\ & & \vdots & \end{bmatrix}$$

where w_0 is the actual world, w_1 is a world in which George W. Bush left office mid-term and Dick Cheney assumed the presidency, w_2 is a world in which Kerry defeated Bush in 2004; and so on.

The ICs we consider will always hold either the world or the time constant—that is, each IC will either be evaluated in w_0 as a mapping from times to individuals (as in the first function above), or evaluated at t_0 as a mapping from possible worlds to individuals (as in the fragment shown in the second). An IC with the world or time held constant is simply a special case, and even when the descriptions refer to the IC as a function from "times to individuals" or "worlds to individuals", the domain of the IC is still a set of indices representing a world and a time. (Some consequences of having ICs range over world/time indices, rather than just over worlds or just over times, will be considered at the end of the chapter, in §3.5.1.)[5]

In the first part of this section, we will see why DPs need to have IC meanings available, independently of CQs. Following this, we will consider various proposals that CQs denote ICs, with CQ-embedding predicates taking appropriate meanings. This theory of CQs meanings avoids the shortcomings of the two possibilities examined in the last section and describes much of the data, but like the ones in the previous section, it will ultimately prove inadequate.

3.2.1. The origins of the individual concept

The observation of the ambiguity between type e and type $\langle s, e\rangle$ denotations originated with the invalid "ninety and rising" syllogism in (6), due to Barbara Partee[6] and first appearing in Montague (1973):

(6) a. The temperature is ninety.
    b. <u>The temperature is rising.</u>
    c. $\nVdash$ *Ninety is rising.

No theory of meaning should license (6c) as a conclusion from (6a)-(6b). Montague's explanation of the invalidity is the following. In (6a), where *ninety* denotes an object of type e (in fact, a rigid designator), the sentences equates the individual denoted by *ninety* to the individual denoted by *the temperature*. However, *rise* in (6b) does not denote a predicate of individuals but a predicate of individual concepts, which attributes the property of rising to the individual concept denoted by *temperature*, i.e. the function from an index to the individual that is the temperature at that index.

Intuitively, this sense of *rise* must select an intensional subject, as its meaning is roughly something like the following.[7]

(7) *rise* is true of x at time t iff
  for times t_1 earlier than t, the value of x at t_1 is less than the value of x at t, and
  for times t_2 later than t, the value of x at t_2 is greater than the value of x at t
  $[\![rise]\!]^t = \lambda x_{se} \,.\, [\, [\forall t_1 < t \,.\, x(t_1) < x(t)] \wedge [\forall t_2 > t \,.\, x(t_2) > x(t)] \,]$

x needs to denote a different number at different times, and is thus an individual concept, a function from times to individuals (i.e. individuals which are numbers).

To formalize the difference between the e-denoting and $\langle s, e\rangle$-denoting senses of *temperature*, Montague took nouns to denote objects of type $\langle se, t\rangle$: for instance, *temperature*

[5] Functions will typically be written horizontally instead of vertically, e.g. [1789 → George Washington, ..., 1796 → George Washington, 1797 → John Adams, ...] or [w_0 → George W. Bush, w_1 → Dick Cheney, ...], to save space.

[6] In "Reflections of a Formal Semanticist" (Feb. 2005), Partee explains that the example originated as a question she asked David Lewis, who in turn relayed the puzzle to Montague.

[7] The actual meaning of *rise* is more subtle than this, of course. t_1 and t_2 do not range over all times, just sufficiently pragmatically local times. Nor does the change need to be as monotonic as the definition here suggests: fluctuations are acceptable as long as the overall trend is a rising trend. (Compare *the temperature has been rising all day* vs. *the temperature has been rising all week* vs. *the temperature has been rising ever since the Industrial Revolution*.) For illustrative purposes, however, this rough sense will suffice.

does not denote a set of individuals which are temperatures, but a set of individual concepts that each map indices to temperatures (with the definite article felicitous only when that set has exactly one member).[8] The sentences of the "ninety and rising" syllogism have the following meanings.

(8) a. $\exists x_{se} . [\forall y_{se} . [\text{temperature}(y) \leftrightarrow x = y] \wedge x(w_0) = 90]$
b. $\exists x_{se} . [\forall y_{se} . [\text{temperature}(y) \leftrightarrow x = y] \wedge [\![rise]\!](x)]$
c. $\text{rise}'(\lambda w_1 . 90)$

In (8a), the individual concept *x*—which, the $\forall y$-clause asserts, is the unique IC for which *temperature* is true—is asserted to, in the world of evaluation, have an extension equal to the (rigid designator) 90. In (8b), it is not the value of the individual concept in the world of evaluation of which *rise* is true, but the individual concept itself. Substituting *ninety* for *the temperature* in (6b) is thus not warranted by (6a): the equivalence of, on the one hand, the extension of the unique temperature *x* and, on the other hand, ninety, does not guarantee the equivalence of the unique temperature *x* and the intension of the rigid designator ninety. (In fact, to predicate *is rising* of *ninety* is to say that the intensional predicate $[\![rise]\!]$ is true of the intension of *ninety*. And since the latter is a rigid designator, its intension yields the same value at all indices, and therefore *rise* is not true of it, i.e. (8c) is not true.)

Because Montague's type system required generalizing to the worst case, he required all nouns, and not just *temperature* and *price*, to have $\langle se, t\rangle$ denotations. To distinguish "extensional" common nouns (*dog*, *town*, *semanticist*, ...) from "intensional" ones (*temperature*, *price*, ...), he suggested that the meaning postulate in (9) holds for any extensional noun δ:

(9) $\Box[\delta(x_{se}) \rightarrow \exists u_e . [x = \lambda w . u]]$ (Montague 1974, (20))

This postulate ensures that any ordinary common noun is such that any IC in its denotation (at any given index) is actually a constant function mapping each index to the same individual. *Temperature* and *price*, being exempt from this postulate, have denotations containing individual concepts that map different indices to different individuals. In post-Montagovian terms that do not require all nouns to have the same semantic type, nouns like *temperature* and *price* denote $\langle se, t\rangle$ predicates while common nouns such as *semanticist* and *city* denote $\langle e, t\rangle$ predicates. (We will revisit this assumption of Montague's in §3.4.2.)

3.2.2. Romero (2005): concealed questions as individual concepts

Romero (2005) treats CQs as individual concepts, a move she considers "a parsimonious extension" (§2.1) of the way *know* composes with an interrogative complement. She begins with

[8] Later authors offered various criticisms of this approach. For instance, Bennett (1975) claimed that a number ought not be an individual and that *temperature* should incorporate some sense of measurement. Jackendoff (1979) treats *the temperature is (at) ninety* as naming a point on a scale rather than equating two individuals, analogous to the sentence *the airplane is at 6000 feet*, and therefore the syllogism does not actually have the form $A \text{ is } B \wedge B \text{ is } C \rightarrow A \text{ is } C$.

See Löbner (1981), Lasersohn (2005) for discussion and refutation of these criticisms. Lasersohn offers a very different criticism, to be discussed in §3.4.1.

the interrogative-embedding meaning of *know* in (10). ($Dox_z(w)$ is the set of worlds compatible with what z believes in world w.)

(10) $[\![know_{\text{ques}}]\!]^w = \lambda q_{\langle s, \langle st, t\rangle\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [q(w_1) = q(w)]$

Knowing a question is to have the set of its true answers in all of one's belief worlds be the same as its true answers in the world of evaluation.[9]

Analogously, knowing an individual concept entails having the value of the IC be the same in all one's belief worlds as its value in the world of evaluation.

(11) $[\![know_{\text{CQ}}]\!]^w = \lambda x_{se} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$

A CQ such as *the capital of Italy* denotes the individual concept in (12), a function from an index to the individual which is the capital of Italy at that index.[10]

(12) $\lambda w . \iota x_e . [\text{capital-of-Italy}(x,w)]$ (Romero 2005, 19)

And combining these two meanings, we have:

(13) $[\![\textit{John knows the capital of Italy}]\!]^{w_0} =$
$\forall w_1 \in \text{Dox}_j(w_0)\ [[\lambda w . \iota x_e . \text{cap.-of-Italy}(x,w)](w_1) = [\lambda w . \iota x_e . \text{cap.-of-Italy}(x,w)](w_0)]] \equiv$
$\forall w_1 \in \text{Dox}_j(w_0)\ [\iota x_e . \text{capital-of-Italy}(x,w_1) = \iota x_e . \text{capital-of-Italy}(x,w_0)]$

---

[9] Romero uses a Karttunen (1977) semantics for questions, in which a question denotes the set of true answers and not the set of all answers. As noted in Chapter 1, switching between a Karttunen meaning and a Hamblin meaning is not difficult: the set of true propositions in a question meaning q is $\lambda p_{st} . [q(p) \wedge p(w_1)]$. One way to recast (10) with Hamblin meanings would be:

(i) $\lambda q_{\langle st, t\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [\lambda p_{st} . [q(p) \wedge p(w_1)] = \lambda p_{st} . [q(p) \wedge p(w)]]$

Once we move away from the *know* that takes interrogative arguments and consider one that takes individual concept arguments, the choice between Karttunen and Hamblin semantics will become even less relevant.

[10] This meaning is noteworthy in that it represents a break from the conception of ICs used in Montague (and Heim (1979), discussed below), in two ways. First, Romero uses a presuppositional meaning for the definite determiner rather than the earlier quantificational meaning. Second and perhaps more strikingly, the expression *capital of Italy* denotes a set of individuals (albeit a world-dependent one), rather than a set of individual concepts. We might have expected that *capital of Italy*, like *temperature*, would need to denote a set of ICs, so that in Montague's system *the capital of Italy* would have the denotation in (i), and in Romero's, the presuppositional variant in (ii).

(i) $\lambda P_{se} . \exists x_{se} . [\forall y_{se} . [\text{capital-of-Italy}(y) \leftrightarrow x = y] \wedge P(x)]$
(ii) $\iota x_{se} . [\text{capital-of-Italy}(x)]$

The use of a presuppositional definite determiner, and the distinction between (12) and (ii), will both become crucial in the discussion of Lasersohn (2005) in §3.4. For the time being, we will put on hold any further scrutiny of the meaning in (12), and return to it following the discussion of Lasersohn. Romero's meaning for *price*, as we will see in a moment, looks somewhat closer to Montague's meaning for *temperature*.

which asserts that, in each world compatible with John's beliefs in w_0, the individual that is the capital of Italy in that world is the individual that is the capital of Italy in w_0 (i.e. in each world compatible with John's beliefs in w_0, the capital of Italy is Rome).

A notational aside: because *the capital of Italy* has both the type-*e* denotation "Rome" and the type-$\langle s, e\rangle$ denotation in (12), I will occasionally use capital letters to distinguish the name of an individual concept. For instance, THE-CAPITAL-OF-ITALY names the IC described in (12) and could replace it in (13), thus:

(13′) $\forall w_1 \in \text{Dox}_j(w_0)$ [THE-CAPITAL-OF-ITALY(w_1) = THE-CAPITAL-OF-ITALY(w_0)]

That is, the $\langle s, e\rangle$ function named by THE-CAPITAL-OF-ITALY has the same value in all of John's belief worlds as it does in the actual world.

Heim (1979) observes the following advantage of giving IC denotations to CQs. Consider once again the following syllogism, repeated from (2).

(2) John knows$_{CQ}$ the capital of Italy.
<u>The capital of Italy is the largest town in Italy.</u>
$\not\vdash$ John knows$_{CQ}$ the largest town in Italy.

Heim observes that by making *know*$_{CQ}$ a relation between an individual (the subject) and an individual concept (the object),[11] instead of a relation between two individuals, this syllogism is invalid for much the same reason that the "ninety and rising" syllogism is invalid. The sentences in the syllogism have the following representations (from Heim's (31)), where *know* can be seen as an abbreviation of Romero's meaning above:

(14) $\exists x_{se} \,.\, [\forall y_{se} \,.\, [\text{capital-of-Italy}(y) \leftrightarrow x = y] \wedge \text{know}(x)(\text{john})]$
$\exists x_{se} \,.\, [\; \forall y_{se} \,.\, [\text{capital-of-Italy}(y) \leftrightarrow x = y] \wedge$
$\exists z_{se} \,.\, [\forall v_{se} \,.\, [\text{largest-town-in-Italy}(v) \leftrightarrow z = v] \wedge x(w_0) = z(w_0)]\;]$
$\exists z_{se} \,.\, [\forall v_{se} \,.\, [\text{largest-town-in-Italy}(v) \leftrightarrow z = v] \wedge \text{know}(z)(\text{john})]$

Just as equating ⟦*the temperature*⟧ with the number 90 does not warrant substituting the intension of (the rigid designator) 90 for ⟦*the temperature*⟧, equating the values in w_0 of the individual concepts ⟦*the capital of Italy*⟧ and ⟦*the largest town in Italy*⟧ does not guarantee the identity of the two intensional objects and thus does not warrant substituting the one IC for the other.

3.2.2.1. Challenges for a CQs-as-ICs theory

Heim, however, ultimately rejects the proposal that CQs are ICs for a few reasons. First, she worries that this solution will leave no "ordinary" common nouns. Remember that IC-denoting common nouns are exempt from the meaning postulate in (9), while ordinary common noun denotations must satisfy it; or that nouns with IC meanings denote $\langle se, t\rangle$ objects while other

[11] "Roughly characterized, this relation of knowing holds between [an individual] X and [an individual concept] Y at *i* iff X is at *i* able to identify the value Y(*i*) that Y yields when applied to *i*" (p. 56); this rough characterization is what Romero formalizes in her meaning for *know*$_{CQ}$ in (11).

nouns denote $\langle e, t\rangle$ objects. Heim's concern is that an increasing number of NPs (in addition to *capital*,[12] *favorite drink*, and *thing that John did*) will need to be exempt from the postulate—or will need to denote $\langle se, t\rangle$ and not $\langle e, t\rangle$ predicates—and no extensional common nouns will be left in the grammar. She mentions this twice in passing, noting that "maybe we could live with that" (p. 57) before moving on to her primary objection, but we will revisit this objection and consider a solution to it (from Lasersohn 2005) in §3.4.1.

Her primary objection, and the one more relevant to Romero's theory about CQs, concerns the ambiguity she observes in the sentence in (15).

(15) John knows the price that Fred knows. (Heim 1979, (34))

For either reading of the sentence, there's something such that Fred knows how much it costs (e.g., milk). On one reading (I will follow Romero (2005) in designating it *Reading A*), John knows how much this thing costs as well, though he may know nothing about Fred or Fred's knowledge. On the other reading, *Reading B*, John need not know what the thing costs, but he knows that Fred knows what it costs. The two meanings can be paraphrased as in (16).

(16) a. John knows the same price Fred knows. (Reading A only)
b. John knows what price Fred knows. (Reading B only) (Romero 2005, (23)-(24))

Giving CQs question paraphrases, this can be thought of as Fred knowing the answer to a question (e.g. "what is the price of milk?"), and John knowing either the answer to that question, or the answer to the meta-question "which question does Fred know the answer to?".[13]

The problem Heim finds in the IC approach to CQs is that it can assign only one logical representation to (15),

(17) $\exists x_{se} . [\forall y_{se} . [[\text{price}(y) \wedge \text{know}(y)(\text{fred})] \leftrightarrow x = y] \wedge \text{know}(x)(\text{john})]$

which corresponds to Reading A (note that $[\![know]\!]_{\langle se,\, et\rangle}$ relates John and the actual individual concept that Fred knows). Capturing Reading B requires a higher type for *price*, so that the "price" John knows is an "individual concept concept"—consequently, the variable x must have type $\langle s, se\rangle$ and not just $\langle s, e\rangle$. (Though Heim does not explicitly say so, *know* must also have a higher-typed homonym which can take the higher-typed x as its first argument: that is, in addition to the $\langle se, et\rangle$-typed *know* needed for Reading A, there must be one with type $\langle\langle s, se\rangle, et\rangle$ to relate John to the "individual concept concept" that he knows.)

Moreover, the type can go arbitrarily high:

---

[12] Or perhaps *capital of Italy*; and additionally *town*, or *largest town*. Because it is *largest town in Italy* and *capital of Italy* that apparently have the $\langle se, t\rangle$ denotations, the denotations of *town* and *capital* may be somewhat different. But the internal compositional details of the NPs will be put off until the next chapter.

[13] In regard to Heim's pragmatics-based proposal, discussed above in §3.1, Romero (2005) observes a singularly striking fact: it cannot capture the ambiguity Heim found in (15)! Because KNOW(P) relates both the matrix subject and the embedded subject to an actual individual denoted by *the price*, both John and Fred must actually know the price in question. Even having the matrix *know* use the property of being the price Fred knows, the sentence will mean something like "Fred knows \$1.99/gallon as the price of milk; and John knows \$1.99/gallon as the price Fred knows"; but for Reading B of (15), John need not have any knowledge about "\$1.99/gallon".

(18) John knows the price known to Fred that Bill knows. (Heim 1979, (36))

This sentence is in fact four-ways ambiguous; let's label the readings W-Z.

(19)

Reading	Fred knows:	Bill knows:	John knows:
W	some price	the same price as Fred	the same price as Bill
X	some price	which price Fred knows	the same price as Bill
Y	some price	the same price as Fred	which price Bill knows
Z	some price	which price Fred knows	which price Bill knows

Reading W is like Reading A, above: all three prices are $\langle s, e\rangle$ objects. Reading Z is like Reading B, in that each price has a successively higher type: Fred knows the answer to a question such as *what is the price of milk?*, Bill knows the answer to the meta-question *which price does Fred know?*, and John knows the answer to *which price does Bill know?*, which is a meta-meta-question, as its answer is not "the price of milk" but rather "which price Fred knows". Readings X and Y are somewhere between the two, requiring only $\langle s, e\rangle$ and $\langle s, se\rangle$ denotations.[14]

Regardless of the first three readings, Reading Z will require a higher type for *price* than Readings A and B above did, namely an $\langle s, \langle s, se\rangle\rangle$ type. And, setting aside performance issues, this ambiguity can continue indefinitely, necessitating an infinite number of homonyms for *price* (and, inferably, for *know* as well—one for each type *price* has).

Romero (2005) observes that the need for arbitrarily high types for *know* (if not also for *price*) does not in itself necessitate rejecting this theory, as two meanings of *know* may "perform exactly the same operations and vary only in the type...of their first argument" and may therefore be "simply crosscategorial variants of each other, comparable to crosscategorial conjunction (Partee and Rooth 1983)" (§2.4.2). (We will see two such variants in a moment.) But simply using a higher type for the trace of *price* does have a more basic problem: while John knows the value of the $y_{\langle s, se\rangle}$ which is a price, what Fred knows is the value of *the value of* y, not the value of y itself. In other words, while the logical representation analogous to (17) would be the following, the *know* that relates Fred to $x_{\langle s, se\rangle}$ is not the same *know* that relates John to $y_{\langle s, se\rangle}$; instead, it must instead extensionalize x and relate Fred to the resulting $\langle s, e\rangle$ meaning.

(20) $\exists y_{\langle s, se\rangle} . [\forall x_{\langle s, se\rangle} . [[\text{price}(x) \wedge \text{know}(x)(\text{fred})] \leftrightarrow y = x] \wedge \text{know}(y)(\text{john})]$

Spelling this out with meanings for *know* of the sort given above, we get the following (adapted from (42) in Romero):

[14] Romero (2005) uses a simpler example:

(i) John knows the price Fred knows: the price announced yesterday morning.

In this case, rather than Fred knowing the answer to a question and John knowing the answer to the meta-question about Fred's knowledge, Fred knows the answer to a metaquestion and John knows the answer to the meta-meta-question. The principle is the same; the rising type of *price* may be easier to conceptualize.

(21) $\forall w_1 \in \text{Dox}_{\text{john}}(w_0)$. [
$\iota x_{\langle s, se\rangle}$ [price(x) $\wedge$ $\forall w_2 \in \text{Dox}_{\text{fred}}(w_0)$ [$\boldsymbol{x(w_0)}(w_2) = \boldsymbol{x(w_0)}(w_0)$] ($w_1$) =
$\iota x_{\langle s, se\rangle}$ [price(x) $\wedge$ $\forall w_2 \in \text{Dox}_{\text{fred}}(w_0)$ [$\boldsymbol{x(w_0)}(w_2) = \boldsymbol{x(w_0)}(w_0)$] ($w_0$)]

The bolded "$x(w_0)$" indicates the extensionalization of the metaquestion about prices into a simple question about prices; it is the value of this extensionalization that must be the same in Fred's knowledge worlds as it is in w_0, whereas it is the value of x itself that must be the same in John's knowledge worlds as it is in w_0.

This higher-typed *price* theory still has the $\langle se, et\rangle$ meaning of *know*, used for ordinary CQ objects like *the capital of Italy* and for Reading A; additionally, it needs two different $\langle\langle s, se\rangle, et\rangle$ meanings. First, there is the one in (22b), used in the matrix clause to make John's knowledge comprise the answer to the metaquestion. Second, there is the one in (22c), used in the relative clause *that Fred knows* to make Fred's knowledge comprise the answer to the actual question about the price of something, and not the answer to the metaquestion.

(22) a. $[\![know_{CQ1}]\!]^w = \lambda x_{se} .\ \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$ (= (11))
b. $[\![know_{CQ2}]\!]^w = \lambda x_{\langle s, se\rangle} .\ \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$
c. $[\![know_{CQ3}]\!]^w = \lambda x_{\langle s, se\rangle} .\ \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w)(w_1) = x(w)(w)]$

The first two of these, which differ in the types of their arguments but which "perform exactly the same operations" on those arguments, are unproblematic crosscategorial variants. The third, however, is not, as it differs in more than the mere type of its arguments.

Heim's objection to using ICs as CQs—that the lexicon will need infinitely many homonyms which are not crosscategorial variants—now seems quite valid. Romero notes, however, that having (22c) in the lexicon creates more fundamental problems. While these meanings for *know* can generate Reading A and Reading B, as shown in (23a) and (23b) respectively, they also generate a third reading when the two senses of *know* used for Reading B are switched, as shown in (23c).

(23) a. John knows$_{CQ1}$ the price$_{\langle se, t\rangle}$ that Fred knows$_{CQ1}$ (Reading A)
b. John knows$_{CQ2}$ the price$_{\langle\langle s, se\rangle, t\rangle}$ that Fred knows$_{CQ3}$ (Reading B)
c. #John knows$_{CQ3}$ the price$_{\langle\langle s, se\rangle, t\rangle}$ that Fred knows$_{CQ2}$ (Reading B′)

The sentence in (23c) is true if there is a price question that John knows the answer to and a price metaquestion that Fred knows the answer to (rather than the other way around, as in Reading B). However, the sentence *John knows the price Fred knows* lacks this reading.

At this point, it seems that IC meanings cannot be used for CQs. What, then, is Romero's solution to the problems just presented?

3.2.2.2. An answer to the challenges

Romero uses *know*$_{CQ1}$ and *know*$_{CQ2}$ in the same manner as the theory just described: the former for knowledge, the latter for metaknowledge. But rather than have *price* be ambiguous between a predicate of ICs and IC concepts (i.e. between types $\langle se, t\rangle$ and $\langle\langle s, se\rangle, t\rangle$), Romero derives an $\langle s, se\rangle$ meaning for *the price that Fred knows* by intensionalizing the $\langle s, e\rangle$ meaning used in

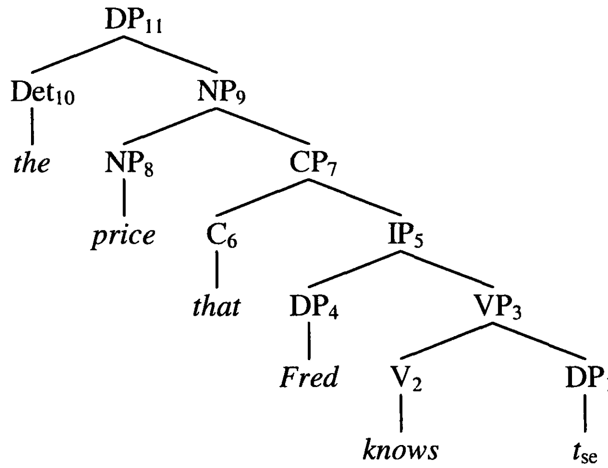
Reading A.[15] Consequently, the problematic *know*$_{CQ3}$ in (22c) is unnecessary, and the two readings need only the available meanings of *know*:

(24) a. John knows$_{CQ1}$ [the price$_{\langle se,\, t\rangle}$ that Fred knows$_{CQ1}$]$_{se}$ (Reading A)
b. John knows$_{CQ2}$ [the price$_{\langle se,\, t\rangle}$ that Fred knows$_{CQ1}$]$_{\langle s,\, se\rangle}$ (Reading B)

These are the rough schemata; the compositional details follow.

As (24) suggests, Romero gives *price* the denotation of a set of ICs; the relative clause *that Fred knows*, which has a trace of type $\langle s, e\rangle$, has the same type; and the two compose via predicate modification. Hence both Reading A and Reading B use the same $\langle s, e\rangle$ denotation for the DP, which is illustrated in (25), from Romero's (30).[16]

(25)



[15] More accurately: in Romero's system, the world variable in *the price that Fred knows* is already bound—the compositional principles generate its denotation with the type $\langle s, se\rangle$. Extensionalizing the denotation produces Reading A; leaving it intensional produces Reading B. I will continue to derive meanings in the opposite manner, and speak as if Romero does the same: generating $\langle s, e\rangle$ meanings, leaving them extensional to produce Reading A, intensionalizing to produce Reading B. In any case, the meanings are the same; the difference is notational.

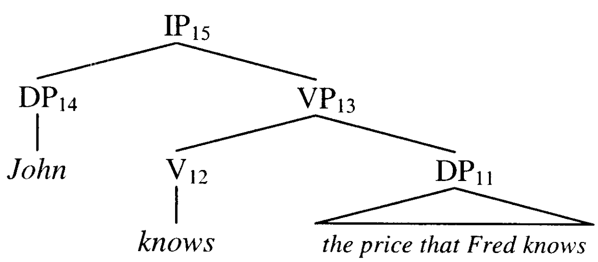
[16] As noted in the introduction, $[\![...]\!]$ here abbreviates $[\![...]\!]^{g,\, w}$: in particular, which variable the trace denotes depends on the assignment function *g*, but as the variable will become bound a few compositional steps later, we can safely ignore *g*. Similarly, all formulae are given as evaluated at world *w*; Romero, rather than including *w* as part of the evaluation function, puts an explicit bound world variable into each expression, but as the previous footnote observed, this is by and large only a difference in notation for our purposes (footnote 17 will point out an exception).

1	y_1	$\langle s, e\rangle$	$[\![t_{se}]\!]$
2	$\lambda x_{se} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$	$\langle se, et\rangle$	$[\![\mathit{know}_{\text{CQ1}}]\!]$
3	$\lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [y_1(w_1) = y_1(w)]$	$\langle e, t\rangle$	2(1)
4	fred	e	$[\![\mathit{Fred}]\!]$
5	$\forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y_1(w_1) = y_1(w)]$	t	3(4)
6	lambda-abstraction introduction		
7	$\lambda y_{se} . \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]$	$\langle se, t\rangle$	$\lambda y . 5$
8	$\lambda x_{se} . \text{price}(x)$	$\langle se, t\rangle$	$[\![\mathit{price}]\!]$
9	$\lambda y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]$	$\langle se, t\rangle$	$7 \wedge 8$
10	$\lambda P_{\langle se, t\rangle} . \iota x_{se} . P(x) = 1$	$\langle\langle se, t\rangle, se\rangle$	$[\![\mathit{the}]\!]$
11	$\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]$	$\langle s, e\rangle$	10(9)

That is, *the price that Fred knows* is the unique individual concept y such that (a) y is a price and (b) y has the same value in the world of evaluation as it does in all of Fred's knowledge-worlds. For instance, if Fred knows the price of milk and no other price, then the only individual concept whose value is the same in the actual world and in all of Fred's knowledge-worlds is the individual concept denoted by *the price of milk*, i.e. the individual concept THE-PRICE-OF-MILK.

Reading A uses the same $\mathit{know}_{\text{CQ1}}$ in the matrix clause as the one in the relative clause.

(26)



11	$\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]$	$\langle s, e\rangle$	(above)
12	$\lambda x_{se} . \lambda z_e . \forall w_2 \in \text{Dox}_z(w)\ [x(w_2) = x(w)]$	$\langle se, et\rangle$	$[\![\mathit{know}_{\text{CQ1}}]\!]$
13	$\lambda z_e . \forall w_2 \in \text{Dox}_z(w) . [$ $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]](w_2) =$ $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]](w)\ ]$	$\langle e, t\rangle$	12(11)
14	john	e	$[\![\mathit{John}]\!]$
15	$\forall w_2 \in \text{Dox}_{\text{john}}(w) . [$ $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]](w_2) =$ $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]](w)\ ]$	t	13(14)

Note that $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]](w)$ cannot be simplified by lambda-conversion, because the expression in larger brackets, which takes a world as its argument, is equivalent to a particular function from worlds to individuals. We could, however, substitute another name of the IC $[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [y(w_1) = y(w)]]]$ (as the world variable w is not bound, but has its value supplied by the evaluation function, this will not affect the truth conditions). Suppose, as above, that the only individual concept which is a price and which is known to Fred in w is the price of milk. Then the bracketed expression picks out in

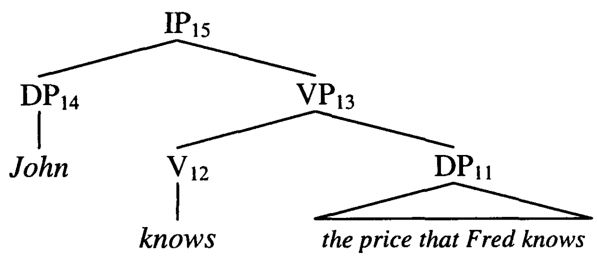
w the individual concept denoted by *the price of milk*, and the sentence *John knows the price that Fred knows* denotes

(27) $\forall w_2 \in \mathrm{Dox}_{\mathrm{john}}(w)\ .\ [\textsc{The-Price-of-Milk}(w_2) = \textsc{The-Price-of-Milk}(w)]$

which is equivalent to $[\![$*John knows the price of milk*$]\!]^w$. This is the right meaning for Reading A: there's a price that Fred knows (in this case, the price of milk), and John knows it too.

Reading B uses, instead of $know_{\mathrm{CQ1}}$ in the matrix clause, $know_{\mathrm{CQ2}}$. Because *the price that Fred knows* denotes an IC and the first argument of $know_{\mathrm{CQ2}}$ is the intension of an IC, the two combine via intensionalized function application.[17]

(26′)



11	$\iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w)\ [y(w_1) = y(w)]]$	$\langle s, e\rangle$	(above)
12	$\lambda y_{\langle s, se\rangle}\ .\ \lambda z_e\ .\ \forall w_2 \in \mathrm{Dox}_z(w)\ [y(w_2) = y(w)]$	$\langle\langle s, se\rangle, et\rangle$	$[\![know_{\mathrm{CQ2}}]\!]$
13	$\lambda z_e\ .\ \forall w_2 \in \mathrm{Dox}_z(w)\ .\ [$ $[\lambda w_3\ .\ \iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w_3)\ [y(w_1) = y(w_3)]]](w_2) =$ $[\lambda w_4\ .\ \iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w_4)\ [y(w_1) = y(w_4)]]](w)\ ]$	$\langle e, t\rangle$	12(^11)
	$\equiv \lambda z_e\ .\ \forall w_2 \in \mathrm{Dox}_z(w)\ .\ [$ $\iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w_2)\ [y(w_1) = y(w_2)]] =$ $\iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w)\ [y(w_1) = y(w)]]\ ]$		
14	john	e	$[\![John]\!]$
15	$\forall w_2 \in \mathrm{Dox}_{\mathrm{john}}(w)\ .\ [$ $\iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w_2)\ [y(w_1) = y(w_2)]] =$ $\iota y_{se}\ .\ [\mathrm{price}(y) \wedge \forall w_1 \in \mathrm{Dox}_{\mathrm{fred}}(w)\ [y(w_1) = y(w)]]\ ]$	t	13(14)

In step 13 here, unlike in step 13 of the previous derivation, lambda-conversion *can* simplify the formula, thereby returning the extension of the intensionalized individual concept at the different worlds. Again supposing that it's the price of milk that Fred knows in w, the denotation of the overall IP can simplify somewhat, to

---

[17] When abstracting over the world of evaluation, $\lambda w\ .\ [\![$*the price that Fred knows*$]\!]^w$, there is in fact a world variable being neglected in the formulae in the text: the one implicit in *price*(y). $[\![$*price*$]\!]^w$ in truth denotes not $\lambda y\ .\ \mathrm{price}(y)$, but something like $\lambda y\ .\ \mathrm{price}_w(y)$, "the set of ICs y such that y is a price **in world** w". Romero, I have noted in previous footnotes, does include this explicit world variable, and binds it properly via when lambda-abstracting over worlds. Nevertheless, omitting it here has no effect on the truth values and serves to make the formulae clearer by removing an irrelevant complication. (Briefly: there is no effect because individual concepts that are prices at one index are necessarily prices at all indices. This will be discussed in more detail in §3.4.1, with respect to an observation of Anil Gupta's.)

(28) $\forall w_2 \in \text{Dox}_{\text{john}}(w)$.
$[\iota y_{se} . [\text{price}(y) \wedge \forall w_1 \in \text{Dox}_{\text{fred}}(w_2)\ [y(w_1) = y(w_2)]] = \text{THE-PRICE-OF-MILK}]$

Here, the actual value of the IC *the price of milk* at the world of evaluation (or any other world) doesn't appear as part of John's knowledge. This corresponds with the paraphrase of Reading B given above, in which John need not know what milk actually costs. Instead, the assertion is that the IC which is a price, and which is the same in each of John's knowledge-worlds as it is in the worlds compatible with what Fred knows *in those worlds*, is the IC whose value Fred actually does know (i.e. the one denoted by *the price of milk*).

Romero's theory of individual concepts and their intensions properly derives Reading A and Reading B, while avoiding the unavailable Reading B′ derivable when only extensions of ICs are used. Using these two readings as a starting point, readings with arbitrary high meta-knowledge can be derived with a fully crosscategorial *know*, suggested by $know_{\text{CQ}_1}$ and $know_{\text{CQ}_2}$ and given explicitly in (29),

(29) $[\![know_{\text{CQ}_n}]\!]^w = \lambda x_{\langle s, \sigma\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$

along with the possibility of an arbitrarily high trace in the relative clause. Thus, no matter how high the meta-question about prices to which Fred knows the answer, the sentence *John knows the price that Fred knows* can have the meaning in (30), using the same composition principles seen above.

(30) $[\![knows_{\text{CQ}_{n+1}}]\!](\lambda w\ [\iota x_{\langle s, \sigma\rangle} . [\![price]\!]_{\langle\langle s, \sigma\rangle, t\rangle}(x) \wedge [\lambda y . [\![knows_{\text{CQ}_n}]\!]^w(y_{\langle s, \sigma\rangle})(\text{fred})](x)])(\text{john})$

In this case, $[\![know_{\text{CQ}_{n+1}}]\!]$ takes an argument with type $\langle s, \langle s, \sigma\rangle\rangle$, and therefore composes with *the price that Fred knows* via intensionalized function application.

3.2.3. Romero and the PCQC

As we explore individual concepts in the next sections, we will find semantic reasons to reject them as denotations of CQs. Before we do so, however, a few words are in order about the syntactic predictions of Romero (2005). In particular, having rejected the Autonomy Hypothesis because of its inability to capture the PCQC, we should consider how Romero's theory fares. In fact, it will turn out that her theory neither fails in any obvious way, nor succeeds in any obvious way.

The meanings in (31) are the familiar variations of *know*, taken from Romero and used throughout this section, with the addition of Romero's declarative-embedding *know*.

(31)
$[\![know_{\text{decl}}]\!]^w = \lambda p_{\langle s, t\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [p(w_1) = 1]$
$[\![know_{\text{ques}}]\!]^w = \lambda q_{\langle s, \langle st, t\rangle\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [q(w_1) = q(w)]$
$[\![know_{\text{CQ}_1}]\!]^w = \lambda x_{\langle s, e\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [x(w_1) = x(w)]$
$[\![know_{\text{CQ}_2}]\!]^w = \lambda y_{\langle s, se\rangle} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w)\ [y(w_1) = y(w)]$

As Romero does not discuss $know_{\text{declarative}}$ at any length, she deliberately sets aside the full details of the meaning of *know* (in particular, its factivity).

What predictions does Romero's cluster of meanings make for the distribution of CQs—in particular, how does it distinguish *know* from *wonder*? In a theory where CQs have IC meanings, only verbs which semantically compose with IC arguments can embed CQs. If only $know_{CQ1}$ and $know_{CQ2}$ are crosscategorial variants of one another, then the lexicon only needs to specify a templatic version as a meaning of *know*, such as (32).

(32) $[\![know_{CQ}]\!]^w = \lambda x_{\langle s, \sigma\rangle} . \quad \lambda z_e . \forall w_1 \in Dox_z(w) [x(w_1) = x(w)]$, where σ is e or se[18]

Predicates like *know* have an $\langle\langle s, \sigma\rangle, et\rangle$ denotation; those like *wonder* do not. In this case, the ability to embed CQs is essentially an arbitrary fact about predicates. Any predicate might happen to have a denotation whose first argument is an (arbitrarily highly) intensionalized individual, independent of other denotations, making it accidental that, e.g., *know* has one but *wonder* does not. While the ability to embed CQs now follows from a semantic fact rather than, as in Grimshaw/Pesetsky, a syntactic fact, the distribution is as impossible to predict.

On the other hand, we could extend the crosscategorial variation to $know_{question}$, which also equates the value of an intensional object in all the subject's belief worlds to its value in the world of evaluation. This would give the more general template in (33)

(33) $[\![know]\!]^w = \quad \lambda x_{\langle s, \sigma\rangle} . \quad \lambda z_e . \forall w_1 \in Dox_z(w) [x(w_1) = x(w)]$, for any semantic type σ[19]

Suppose now that $[\![wonder]\!]$ takes the intension of a set of propositions as its argument and expresses something about the subject's relation to that intension—for example, that the subject wants to know what the extension is (which is to say, wants to know what the true answers to the question are). Then either *wonder* is specified as having only a $wonder_{question}$ meaning and not a templatic one, which brings us back to the difference being accidental; or else the same sort of crosscategorial meaning seen in *know* should be available for *wonder*. That is, there should be an $\langle se, et\rangle$ variation of the $\langle\langle s, \langle st, t\rangle\rangle, et\rangle$ meaning, which would take a CQ as its argument and express a relation between the subject and the individual that corresponds to the value of the CQ.

---

[18] Or $\langle s, se\rangle$, $\langle s, \langle s, se\rangle\rangle$, etc., to capture Reading Z of Heim's ambiguity, and so on arbitrarily high.

[19] If σ can have any type at all, it can have type t, in which case the meaning in (i) would be possible:

(i) $[\![know_{decl}]\!]^w = \quad \lambda p_{\langle s, t\rangle} . \ \lambda z_e . \forall w_1 \in Dox_z(w) [p(w_1) = p(w)]$

This is not equivalent to the $know_{decl}$ in (31). However, they do have identical truth conditions once we take into account that declarative *know* is factive, because if *know* is factive, it must be the case that in the world of evaluation w, $p(w) = 1$. (That is to say, this latter formula replaces one object, the truth value "1", with something coextensional.)

We might hesitate to adopt (i) as the actual meaning of $know_{decl}$, but it does underscore that, with the factivity restriction, Romero's $know_{decl}$ also equates the value of an intensional object (i.e. a proposition) in all the subject's belief worlds to its value in the world of evaluation (which is, necessary, "1" or "TRUE"). In this case, all four meanings might be considered variants of one another, at which point we might expect any proposition-embedding predicate to have a question-embedding meaning as well, or vice versa, so that propositions and questions have the same distribution. I will not examine this prediction further here; I mention it only as a further qualm about Romero's system of meanings. (Though out of fairness, a similar challenge will arise in Chapter 5 when we try to derive the PCQC from the theory that CQs denote propositions.)

(34) a. $[\![wonder_{\text{ques}}]\!]^w = \lambda q_{\langle s, \langle st, t\rangle\rangle} . \lambda z_e$. [z wants to know what q's value in w is]
b. * $[\![wonder_{\text{CQ}}]\!]^w = \lambda x_{\langle s, e\rangle} . \lambda z_e$. [z wants to know what x's value in w is]

I do not intend to suggest that the meaning in (34a) is necessarily the correct meaning for *wonder*, only that it is an example of what such a meaning might be and how it, like *know*, would have a CQ-embedding crosscategorial variant.

All told, a thorough understanding of how crosscategorial *know* captures the predictable distribution of CQs requires deeper examination of lexical meanings for the various categories of verbs. This kind of examination is not only beyond the scope of this dissertation, it is outside the scope of Romero (2005) as well: Romero's paper explores the meanings of CQs (and their relation to DPs used as specificational subjects of copulars), and its intent is not to explain either the distribution of CQs nor the details of the verb meanings.

Based on this section's examination of which predicates allow or disallow CQ objects, we cannot immediately reject the theory that CQs denote ICs; but neither can we wholeheartedly adopt it. In the remainder of this chapter, we will examine the theory's predictions about which DPs can or cannot be CQs, which will provide a clearer reason to consider other denotations.

3.3. Some Problems with Concealed Questions as Individual Concepts

Treating CQs as denoting (intensionalizable) ICs seems to derive the correct truth conditions. But there are a number of reasons to think that concealed questions are not simply individual concepts. An initial argument that CQs aren't ICs parallels the ones we saw against treating CQs as individuals: a predicate that takes an intensional subject, such as *rise*, cannot conjoin with a CQ-taking predicate. Two predicates that select IC subjects can conjoin, as we would expect, and two passivized CQ-embedding predicates can also conjoin with a CQ subject. However, a single DP cannot serve as both the IC subject of *rise* and the CQ subject of passivized *know*.

(35) a. [The price of milk]$_{\text{IC}}$ fell last week and is rising this week.
b. [The price of milk]$_{\text{CQ}}$ is known to John and has been forgotten by Fred.
c. * [The price of milk]$_{??}$ fell last week and is known to John.

Just as similar data demonstrated that CQs are not individuals, the fact here suggests that the CQ object of *know* denotes something different than the subject of *rise* does. As the latter is an individual concept, the CQ cannot be one.[20]

A second, more fundamental problem is that, while "individual concept" is a useful label for functions from worlds to individuals, Romero does not explore the details of which noun phrases can be ICs and how. In her analysis, *price* denotes a set of individual concepts, as does *that Fred knows*, and via function modification the two together also denote a set of individual concept. But *price of milk* presumably also denotes a set of individual concepts; does *of milk* denote the set of individual concepts that are somehow "of milk"? And what of Heim's concerns about the spread of $\langle se, t\rangle$ meanings to NPs such as *thing that John did* and *John's favorite drink*?

The theory proposed in the next chapter will face many of the same questions, though with respect to propositional denotations instead of individual concept denotations. All the same,

[20] This might be resolved in Romero's system by separating world and time variables. As the chapter progresses, such an approach will seem less appealing; see §3.5.1 for discussion.

the more we look at individual concepts and the internal composition of CQs, the less well-suited ICs will seem as CQ meanings. In this section, we will examine Janssen (1984) and Lasersohn (2005), from whom we will conclude that many DPs that have IC denotations nevertheless cannot be CQs.

3.3.1. Janssen (1984): the useful (but widespread) individual concept

In §3.2.1, we saw Montague's argument that certain DPs denote individual concepts, and moreover that certain common nouns such as *temperature* denote sets of ICs. Janssen (1984) observes that ICs are more ubiquitous than the "ninety and rising" argument might suggest, and they are, to borrow his word, "useful" throughout the grammar.

Janssen discusses a variety of contexts in which ICs seem to be necessary. He claims that concealed questions are ICs, citing Heim and offering a solution to her concern about rising homophones.[21] He also discusses discourse anaphora as a construction that seems to require ICs, which I will not explore further here.

Of more interest to the current exploration of the distribution of ICs are certain other predicates which he argues either must be ICs or must take IC arguments. The former type includes name-like titles, which are unlike rigid designators in that they denote different individuals at different times. For instance, Geach (1979; discussion taken from Janssen) discusses titles of the members of Herald's College such as *Portcullis* and *Rouge-Dragon*, which refer to different people at different times. Thus if Alex talks to Portcullis at one time and Chris talks to Portcullis at another after the title has passed to a new person, one might say that they talked to "the same herald" (i.e. they both talked to Portcullis) but not "the same person". Janssen models this by taking titles like *Portcullis* to name individual concepts, and nouns like *herald* to denote sets of individual concepts.

Janssen does not extend the discussion of this kind of title to more compositional expressions. Nevertheless, considering a context in which USNDH has (by policy) a single semanticist, a single syntactician, and a single phonologist, I think it is coherent to say

(36) Alex talked to the USNDH semantics professor, and later Chris talked to the same professor.

if Alex and Chris talked to two different people, both of whom held the same position at different times. That is, *same* does not equate two individuals, the one Alex talked to and the one Chris talked to; it equates two individual concepts, the one whose value at t_1 Alex talked to at t_1, and the one whose value at t_2 Alex talked to at t_2. (To make the sentence sound natural, contrastive focus on *semantics* may be necessary, creating the focus set {⟦*the USNDH semantics professor*⟧, ⟦*the USNDH syntax professor*⟧, ⟦*the USNDH phonology professor*⟧}, which is then a set of individual concepts. Alternately, it might require USNDH to have one of each professor as a matter of departmental policy.) The use of compositionally formed titles and not just preassigned titles as ICs broadens the set of predicates that can be ICs even further.

The set of predicates that must be ICs also includes *home*, as in (37), from Partee (1970):

[21] In particular, he suggests that a variable of any intensional height ($\langle s, se\rangle$, $\langle s, \langle s, se\rangle\rangle$, etc.) can be turned into an appropriate complement for the single, Groenendijk-and-Stokhof-based meaning for *know*. This higher variable can be extensionalized down to $\langle s, e\rangle$ when made the argument of the IC, eliminating the need for homonyms of the noun with denotations higher than $\langle se, t\rangle$.

(37) My home was once in Maryland, but now it's in Los Angeles.

In contrast to the same sentence with *house* in place of *home*, which would be true only if the physical object moved, (37) asserts a fact about the value of the denotation of *my home* at a time in the past and at the present time. This means that *one's home* denotes a function that maps a time to one's home at that time, which is to say an individual concept.[22]

The disparate nature of the uses Janssen describes, from concealed questions to titles to other commonplace predicates, suggests that ICs are more widespread than believed by, e.g., Bennett (1974), who considered *rise* and *temperature* to be "extraordinary" and rationalizes away their status as predicates of individual concepts. However, it is Janssen's discussion of *change*, which (like *rise*) needs an intensional subject, that opens the floodgates for ICs to become truly pervasive.

Following Link (1979) and Löbner (1979, 1981), Janssen discusses the following examples.

(38) Der Trainer wechselt/The trainer changes.[23] (Janssen, (4)-(5), from Link 1979)

(39) a. The mayor changes.
b. The mayor is the husband of Helga.
c. The husband of Helga changes. (Janssen, (7)-(9), from Löbner 1981)

The latter follows the same pattern as the "ninety and rising" paradox, suggesting in the same way that *change* must denote a property of ICs and that the subject must be an IC. Of the former, Janssen observes that in situations that make it true, there is no unique "trainer" individual of whom we can say that a change occurred. (38) is true if, for instance, a certain club employs Alex as their trainer, and then Alex leaves the position and Bobby assumes the role. So it's true that Alex has changed (in the extensional sense) and that Bobby has changed, but there's no one individual denoted by *the trainer* who has changed. For this reason, Janssen makes the same move for *change/wechseln* as Montague did for *rise*, taking it to denote a predicate of type $\langle se, t\rangle$, and giving (38) the meaning:

(40) $\exists x_{se} . [\forall y_{se} . [\text{trainer}(y) \leftrightarrow x = y] \wedge \text{wechseln}(x)]$ (Janssen, (6))

[22] It also suggests that *house*, at least, is immune to Heim's concern that the lexicon will be left with no $\langle e, t\rangle$-denoting nouns. If it is unique in this regard, its resistance to having an $\langle se, t\rangle$ denotation provides little comfort. And if *I know John's favorite house* is acceptable with a CQ meaning (and I think it is), it may not be as immune as we might hope.

[23] English *change* has an extensional meaning, so that this sentence may mean that the individual who is the trainer undergoes some sort of change—new clothes, a new haircut, new political views, or the like. This meaning can be paraphrased "undergo a change", which has no intensional meaning. Thus, *the trainer underwent a change* can only mean that something happened to the individual, and not that someone new is now the trainer.

As with the object of extensional *know*, the subject of extensional *change* can be replaced with a coreferential expression without changing the truth value, and it can be a rigid designator (*Paul changes*). And as with *know* (and *wissen*), German has an unambiguously intensional predicate, *wechseln*. So as with *know*, we can safely ignore the extensional meaning.

So just as *temperature* necessarily denoted a set of individual concepts with type $\langle se, t\rangle$, so does *trainer*. Janssen says of the nouns *trainer* and *mayor* (and others such as *president*, *pope*, and *dean*) that they "describe a public position, and they are, in the sentences under consideration, not used to indicate a particular individual" (p. 176). For this reason, they denote not individuals but individual concepts.

3.3.2. Implications for Romero (2005)

What makes *change* so interesting for the current discussion is this. Analogous to the lexical meaning for *rise* we postulated in (7) at the beginning of the chapter, we can write a meaning for *change*:

(41) $[\![change]\!]^{t} = \lambda x_{se} \, . \, \exists t_1 > t \, . \, x(t_1) \neq x(t)$

This captures the essential truth conditions, namely that *change* is true of a time if there's an earlier time where the IC subject's value was different than it is at the given time. But unlike *rise*, for which the different values of its individual concept must be numbers because they are taken to be higher or lower at different indices, *change* puts no restriction on the range of values its subject can take. So for instance, even though (37) showed that *my home* is an individual concept, *my home rises* is semantically anomalous because the different values *my home* takes at different times cannot be compared quantitatively. *My home changes*, however, has no such anomaly.

Therefore, we can take the conclusion of Romero that CQs have IC meanings and see whether *change* can be predicated of DPs that can be CQs.

(42) a. The temperature changed.
b. The color of Sam's hair changed.
c. The capital of Vermont changed.
d. The semanticist who teaches at USNDH changed.

Each of the sentences in (42) is felicitous, each one asserting that the value of its subject IC took on different values at different times.[24] So equating CQs with ICs might look even more promising.

But while DPs that can have concealed question meanings can be the subject of *change*, many other DPs can be the subject of *change* as well; in fact, nearly any noun can head the DP subject of *change*. Löbner (1981) claims that intensional verbs such as *change* distinguish *functional nouns* (*Funktionalbegriffe*) from *generic nouns* (*Gattungsbegriffe*). He provides *linguist*, *rose*, *noun*, and *old man with a long beard* as examples of the latter, nouns which cannot

[24] (42a) and (42b) warrant particular comment; while one might attempt to claim that *the trainer changed* shows a particular use of extensional *change* applying to two different individuals, such a claim is much harder to maintain for these two sentences. For instance, if Sam's hair was brown and is now red, (42b) is true, but neither "brown" nor "red" has especially changed. True, each has a different set of properties before and after the change (brown no longer has the property "is the color of Sam's hair"; red now has that property), but this sort of change in properties—called a *Cambridge change* in the philosophical literature—is quite different, and certainly would not warrant the rather odd assertions *Brown changed* or *Red changed*.

be used with intensional predicates.[25] Nevertheless, generic nouns can be the subject of *change*. Thus, the (a) sentences in the following examples are felicitous, having exactly the same senses as the other sentences with *change* discussed here (i.e. that the individual picked out by the DP is different now than previously). The (b) sentences show that the same DPs cannot be used as CQs, even when the analogous sentences with clausal questions would be natural ways to continue the conversation.

(43) A: John says he visits his niece Jordan with some frequency, but when I asked him what picture she has on her wall, he had no idea.
a. B: The picture on Jordan's wall changes each month.
b. #That's why John didn't know the picture on Jordan's wall.
(cf. *That's why John didn't know what the picture on Jordan's wall is.*)

(44) A: What's new in the linguistics department at USNDH?
a. B: The semanticist changed.
b. #A: Really? Tell me the semanticist (now).
(cf. *Tell me who the semanticist is (now).*)

Similarly, a painter might complain "The rose changed" if someone replaced the red rose in the still life he was painting with a white rose; a linguist, explaining why *Sam told me the time* is felicitous while *Sam told me the semanticist* is not, might begin by saying, "The noun changes (from one sentence to the other)"; and so on.[26]

This difference in judgments has two consequences for the discussion up to this point. First, while Romero interprets CQs as ICs, it's clear that the ability of a noun to have an IC meaning does not license its use as a CQ. Consider the meaning Romero predicts for a simplified

---

[25] Löbner's terminology may cause some confusion. "Functional noun" usually refers to a noun with, roughly, type $\langle e, e\rangle$: *mother*, for instance, is a function from an individual to the mother of that individual; and as we will see in the next chapter, some authors have postulated a connection between functional nouns in this sense and nouns which can be CQs. As a result, when Löbner writes that "a great variety of count nouns can be used as both functional and generic nouns", explaining of the noun *table* that it

> ...can be understood as a piece of furniture with certain characteristics distinguishing it from desks or stools, or as something with a certain function (for instance, the thing at which one is sitting during one's meals, even though it be a table (in the generic sense), a carton, or a rock). (p.476)

he may seem to anticipate the claim in this paragraph: namely, that many generic nouns can be ICs.

However, his distinction here is somewhat mysterious. It is true that, as I sit here in the Diesel Café, the object on which my laptop currently rests—an object about two and a half feet high, with a flat rectangular top supported by single pole with four feet extending from the bottom—is a *table* in the generic sense, was a table yesterday, will (barring fire or other destructive force) be a table tomorrow. And it is true that the cardboard box on which I rested my laptop after first moving into my apartment was a *table* in a time-and-world-dependent way. But when *table* is used as the subject of *change*, it is not necessarily in this latter sense. Should I come to the Diesel Café tomorrow and find this object and the others like it along this wall replaced by ones three feet high with circular tops supported by four legs each, I could still say "Hey, the tables changed!" The functionality, in Löbner's sense, is irrelevant; what matters is that one (generic) table has replaced another (generic) table.

[26] Many sound somewhat better as the object of transitive *change* rather than the subject of intransitive *change*: *The semanticist changed the noun*, *someone changed the rose*, etc. Transitive *change*, like the intransitive form, has both intensional and extensional senses, as the subject can either cause an object to undergo a change (extensional) or replace one object with another (intensional).

(but still infelicitous) variation on (43b), *John knows the picture on Jordan's wall.* The composition is identical to that of the felicitous sentence *John knows the capital of Italy*, with $\langle s, e\rangle$-embedding *know* (i.e. $know_{CQ1}$) and *the capital of Italy* denoting an individual concept.[27]

(45) $[\![\textit{the capital of Italy}]\!] = \lambda P_{\langle se, t\rangle} . \exists y_{se} . [\forall x_{se} . [\text{capital-of-Italy}(x) \leftrightarrow x = y] \wedge P(y)]$
$[\![know_{CQ1}]\!] = \lambda x_{se} . \lambda z_e . \forall w_1 \in \text{Dox}_z(w) [x(w_1) = x(w)]$
$[\![\textit{John knows the capital of Italy}]\!] =$
$\exists y_{se} . [\forall x_{se} . [\text{capital-of-Italy}(x) \leftrightarrow x = y] \wedge \forall w_1 \in \text{Dox}_{\text{john}}(w) [y(w_1) = y(w)]]$

(46) $[\![\textit{the pic on Jordan's wall}]\!] = \lambda P_{\langle se, t\rangle} . \exists y_{se} . [\forall x_{se} . [\text{pic-on-J's-wall}(x) \leftrightarrow x = y] \wedge P(y)]$
$[\![\textit{John knows the picture on Jordan's wall}]\!] =$
$\exists y_{se} . [\forall x_{se} . [\text{pic-on-J's-wall}(x) \leftrightarrow x = y] \wedge \forall w_1 \in \text{Dox}_{\text{john}}(w) [y(w_1) = y(w)]]$

The latter formula in (46) does capture the expected meaning: in all worlds compatible with John's beliefs, the individual which is the picture on Jordan's wall in that world is the same individual as the picture on Jordan's wall in the actual world. Nevertheless, this meaning is not available to the sentence.

Second, Heim's concern discussed in §3.2.2—that we will run out of ordinary common nouns that denote sets of individuals—has become more pressing now that it is no longer only the occasional "intensional" noun (in Montague's sense) that can have an IC meaning. Moreover, the farther we get from intensional nouns such as *temperature* and *price*, the harder it is to accept the intuition that a common noun is really a property of an individual concept instead of being a property of an individual. For instance, the individual concepts in (47) might reasonably be said to be "a temperature" or "a price", respectively (i.e., a member of the set of index-to-individual mappings that are temperatures or prices).

(47) a. [May 1 → 50°F, May 2 → 51°F, May 3 → 55°F, ...]
b. [January → $1.99/gallon, February → $2.09/gallon, March → $2.04/gallon, ...]

It's somewhat less intuitive that, even for a so-called "public position", the IC in (48a) is somehow "a trainer".

(48) a. [..., 2003 → Alex, 2004 → Alex, 2005 → Bobby, ...]
b. [January → *Guernica*, February → *American Gothic*, March → *Mona Lisa*, ...]

The IC in (48b) is even less intuitively "a picture on Jordan's wall". Nevertheless, Janssen's analysis of *change* as a predicate of individual concepts—which *does* seem correct—apparently necessitates that *trainer* denote a set that includes the former function, and *picture on Jordan's wall*, the latter.

At first glance, individual concepts seemed like a good starting point as a basis for interpreting concealed questions. By this point, however, it seems that they have not only

[27] The meaning in (45) actually uses the Russell-style quantifier over ICs, though Romero uses only a presuppositional definite determiner, in order to maintain parallelism with the Russellian meaning of the definite determiner used by Janssen and discussed above. Using a presuppositional meaning would not change the essence of the argument.

expanded beyond the boundaries of relational nouns and concealed questions, but they are now poised to entirely take over common nouns.

3.4. Further Problems with Concealed Questions as Individual Concepts

In this section, we will bring individual concepts back into line by first drastically reducing their hold on the lexicon and then reintroducing them slowly and in carefully controlled ways. The first step in this process is provided by Lasersohn (2005). Though aimed at a smaller part of the problem, the theory presented in Lasersohn (2005) offers a solution to IC-property proliferation. However, in doing so, it creates an even more fundamental problem for an approach to CQs that gives them IC denotations.

3.4.1. Lasersohn (2005): eliminating the IC-property-denoting common noun

The discussion of individual concepts to this point has varied in its treatment of the definite determiners, sometimes using a quantificational, Russellian meaning and sometimes using a presuppositional meaning. Lasersohn (2005), by using only the presuppositional meaning, offers a simplified way of viewing ICs.

Lasersohn revisits the intuition that *the temperature rises* requires the use of sets of individual concepts. He agrees that knowing the truth conditions of *rise* inherently requires examining different times, and thus Partee was correct to suggest that its subject must be an individual concept. But the same is not true of *temperature*, *price*, or other so-called "intensional" nouns. They have no inherent time- or world-dependence in their meanings; temperatures or prices at other times are irrelevant for evaluating the truth conditions of a sentence about the current temperature or price. *Rise*, therefore, does denote an $\langle se, t\rangle$ object, but *temperature* and *price*, like other common nouns, should denote objects with type $\langle e, t\rangle$ and not $\langle se, t\rangle$.

Additionally, while he dismisses many criticisms of the "ninety and rising" syllogism (see footnote 8), he does find a serious challenge to its conclusions in a problem discussed in Dowty, Wall, and Peters (1981), who credit it to Anil Gupta. This challenge lies in the following variation on the "ninety-and-rising" syllogism:

(49) a. Necessarily, the temperature is the price.[28]

b. <u>The temperature is rising.</u>

c. $\vdash$ The price is rising.

Unlike the "ninety is rising" syllogism, Gupta's syllogism does hold, but the individual concept meanings for *price* and *temperature* spelled out above do not guarantee that it does. Montague's system assigns the following meanings to the three sentences.

(50) a. $\forall w\,.\,\exists x_{se}\,[\,\forall y_{se}\,[\text{temperature}'(y) \leftrightarrow x = y] \wedge$
$\exists z_{se}\,[\forall v_{se}[\text{price}'(v) \leftrightarrow z = v] \wedge x(w) = z(w)]]$

b. $\exists x_{se}\,[\forall y_{se}[\text{temperature}'(y) \leftrightarrow x = y] \wedge \text{rise}'(x)]$

c. $\exists x_{se}\,[\forall y_{se}[\text{price}'(y) \leftrightarrow x = y] \wedge \text{rise}'(x)]$

Now consider the following scenario described in DWP (as spelled out in Lasersohn 2005). Suppose there are three time indices, i_1, i_2, i_3, such that i_1 precedes i_2, which precedes i_3. In this scenario, the temperature and price are index-dependent functions from indices to individuals (i.e. numbers which are temperatures or prices) as follows.

(51) $[\![\textit{the temperature}]\!] = \begin{bmatrix} i_1 \to \begin{bmatrix} i_1 \to 99 \\ i_2 \to 100 \\ i_3 \to 101 \end{bmatrix}, i_2 \to \begin{bmatrix} i_1 \to 89 \\ i_2 \to 90 \\ i_3 \to 91 \end{bmatrix}, i_3 \to \begin{bmatrix} i_1 \to 79 \\ i_2 \to 80 \\ i_3 \to 81 \end{bmatrix} \end{bmatrix}$

$[\![\textit{the price}]\!] = \begin{bmatrix} i_1 \to \begin{bmatrix} i_1 \to 99 \\ i_2 \to 98 \\ i_3 \to 97 \end{bmatrix}, i_2 \to \begin{bmatrix} i_1 \to 91 \\ i_2 \to 90 \\ i_3 \to 89 \end{bmatrix}, i_3 \to \begin{bmatrix} i_1 \to 83 \\ i_2 \to 82 \\ i_3 \to 81 \end{bmatrix} \end{bmatrix}$

In such circumstances, (50a) is true: at each index, there's a unique IC temperature and a unique IC price, and the value of the two ICs at that index are equal. For instance, at i_1, the unique x such that x is a temperature is the function $[i_1 \to 99,\ i_2 \to 100,\ i_3 \to 101]$, and the value of this function at i_1 is 99; the unique price is $[i_1 \to 99,\ i_2 \to 98,\ i_3 \to 97]$, and its value at i_1 is also 99.

Taking the definition of *rise* in (7), repeated here,

---

[28] This sentence—indeed, the entire discussion in Montague of individual concepts, in Lasersohn of Montague's theory, and in Romero of concealed questions—assumes that *temperature* and *price* are simple sets of ICs. In fact, they have another semantic argument, though it's easy in, say, *the temperature is rising*, to have an "of here/now/our environs/etc." argument remain implicit. Properly, *temperature* and *price* in Montague's system should denote $\langle e, \langle se, t\rangle\rangle$ predicates. The sentence here has the additional problem that it is insufficient to merely equate the values of *the temperature* and *the price*, even on the model given here where the latter is an IC; it's certainly not the case that, if the temperature is 90°F, the price of some understood object is 90°F. Pragmatically, (49a) is perhaps best understood as being elliptical for something like *Necessarily, the temperature in degrees Fahrenheit is the price in cents of a can of Coke*.

In the discussion throughout this chapter, glossing over this extra argument has been relatively harmless; nearly all of the points made about, e.g., $[\![\textit{price}]\!]$ as a predicate of ICs could instead be made about, e.g., $[\![\textit{price of milk}]\!]$, without losing the validity of the arguments. This argument will become critical in the next chapter, and I bring it up here in part to foreshadow that discussion, and in part because leaving the arguments of the nouns to be determined pragmatically in the sentence in (49a) is especially striking.

(7) $[\![rise]\!]' = \lambda x_{se} \,.\, [\, [\forall t_1 < t \,.\, x(t_1) < x(t)] \wedge [\forall t_2 > t \,.\, x(t_2) > x(t)] \,]$

(50b) is also true: at each index, the *temperature* function from indices to values yields higher values at later indices. For instance, the extension of *temperature* at i_2, which is $[i_1 \rightarrow 89,\ i_2 \rightarrow 90,\ i_3 \rightarrow 91]$, is an IC such that at all times before i_2, its value is less than its value at i_2 (89 vs. 90), and at all times after, its value is greater (91 vs. 90). However, while the premises of the syllogism are both true, the conclusion in (50c) is false, because at each index the *price* function yields lower values at later indices.

DWP observe that a simple meaning postulate will solve this problem. Lasersohn suggests the one in (52), where α is *temperature* or *price*.

(52) $\forall x_{se} \,.\, \Box\, [\alpha(x) \rightarrow \Box\alpha(x)]$ (Lasersohn 2005, 21)

This requires any mapping from indices to individuals that is an α at one index to be an α at all indices. This rules out the scenario in (51), where the IC which is a temperature (or a price) at any one index is not a temperature (or a price) at other indices, and the syllogism will be valid.

It may solve the problem, but Lasersohn objects to the meaning postulate in (52) for a number of reasons. First, this postulate must hold not only for *temperature* and *price*, but for any lexical item which can be substituted for them in the syllogism; thus, the postulate would have to hold more generally in the lexicon. On the other hand, it cannot hold of common nouns in general, as most nouns do have different extensions at different indices. Second, as the validity of the syllogism lies not in particular facts about the lexical items but in its logical structure, a solution should rely on the logical structure of the formulae and not on alteration of the lexical items in the structure.

For these reasons, Lasersohn looks for an alternate way to interpret *temperature* and *price*. The original motivation for giving relational nouns $\langle se, t\rangle$ denotations, he notes, had nothing to do with their meanings, but only with the assumption that the definite determiner was quantificational. *Rise* and *temperature* had to be predicated of the same variable in Montague's formula in (8b), repeated here.

(8b) $\exists x_{se} \,.\, [\forall y_{se} \,.\, [\text{temperature}(y) \leftrightarrow x = y] \wedge [\![rise]\!](x)]$

But with a presuppositional definite determiner that takes the type-$\langle e, t\rangle$ meaning of the common noun *temperature* as its argument and returns an object with type *e*, *rise* can take the intension of the DP as its argument:

(53) $[\![\textit{the temperature rises}]\!] = [\![rise]\!](\lambda w \,.\, \iota x_e \,.\, [\![temperature]\!]^w(x))$

Spelled out in full, with the meaning for *rise* used above:

(54) $[\![rise]\!]^t = \lambda y_{se} . [\ [\forall t_1 < t . y(t_1) < y(t)] \wedge [\forall t_2 > t . y(t_2) > y(t)]\ ]$
$[\![\textit{the temperature}]\!]^t = \iota x_e . x$ is a temperature at t
$\lambda t . [\![\textit{the temperature}]\!]^t = \lambda t . \iota x_e . x$ is a temperature at t
$[\![\textit{the temperature rises}]\!]^t =$
$\forall t_1 < t . [[\iota x_e . x$ is a temperature at $t_1] < [\iota x_e . x$ is a temperature at $t]] \wedge$
$\forall t_2 > t . [[\iota x_e . x$ is a temperature at $t_2] > [\iota x_e . x$ is a temperature at $t]]$

By taking the intension of the type-*e* DP, Lasersohn eliminates the need for common nouns to lexically denote sets of ICs instead of sets of individuals. And having eliminated $\langle se, t\rangle$ meanings from the grammar, the objectionable postulate in (52) is superfluous. Lasersohn automatically achieves the effect of the postulate, as the intensionalized definite descriptions are necessarily constant across worlds.

As noted, Lasersohn's goal was to simplify the interpretation of sentences like *the temperature rises*. A welcome additional consequence of his theory is the resolution of Heim's worry about the proliferation of IC-property denotations for common nouns. Recall that Janssen, drawing an analogy between *the temperature rises* and *the trainer changes*, was forced to give *trainer*, like *temperature*, the denotation of a property of individual concepts so that it would fit into the meaning in (40), repeated here.

(55) $\exists x_{se} . [\forall y_{se} . [\text{trainer}(y) \leftrightarrow x = y] \ \wedge \ \text{change}(x)]$

Janssen argued that *trainer* was a "public position", justifying the denotation; but we saw that *change* could take as its subject a wide range of definite DPs, and imagining even *trainer* as denoting a property of individual concepts seemed strange, to say nothing of *picture on Jordan's wall*.

Lasersohn's reanalysis of individual concepts provides a straightforward solution to this problem. The predicate *change* no longer necessitates having any common nouns that denote properties of ICs. *Trainer* and *picture on Jordan's wall* can once again denote simple properties of individuals; *the trainer* and *the picture on Jordan's wall* denote individuals, which intensionalize to serve as the argument of *change*.

(56) $[\![change]\!]^t = \lambda x_{se} . \exists t_1 < t . x(t_1) \neq x(t)$
$[\![\textit{the trainer changes}]\!]^t = \exists t_1 < t . [\iota x_e . x$ is a trainer at $t_1] \neq [\iota x_e . x$ is a trainer at $t]$

So for Heim and Janssen, Lasersohn's theory is good news. All nouns have $\langle e, t\rangle$ denotations lexically, and we do not need to worry about all the nouns in the lexicon—or indeed, any of them—ending up with $\langle se, t\rangle$ denotations. Any DP (or at least, any definite description) with a free world variable can become an individual concept.

3.4.2. Implications for theories of concealed questions

Recall the meaning Romero (2005) gives *the capital of Italy*, repeated from (12):

(12) $\lambda w . \iota x_e . [\text{capital-of-Italy}(x,w)]$ (Romero 2005, 19)

Romero takes *capital of Italy* to denote a predicate of individuals and not a predicate of individual concepts; she derives the individual concept denotation of *the capital of Italy* by intensionalizing its type-*e* denotation. In doing so, she independently suggests the same method of avoiding $\langle se, t\rangle$ meanings for nouns as Lasersohn does.

In light of the previous section, however, this method provides an argument against treating concealed questions as individual concepts. Any definite description can have an IC denotation, but not every definite description can be the object of CQ-embedding *know*, which means that an IC-embedding *know* cannot be the right interpretation mechanism for CQs. (Additionally, if Lasersohn is right that *price* does not denote a set of ICs, only a set of individuals, it cannot be modified by the set of ICs denoted by *that Fred knows*. In the next chapter, we will see a way of deriving an $\langle se, t\rangle$ meaning for *price* from its actual lexical meaning, but at the very least, something more must be said on the point.)[29]

On the other hand, the elimination of $\langle se, t\rangle$-denoting nouns threatens more theories than just Romero's. Even if CQs are not individual concepts, the intuitions underlying this chapter stand—that CQs must be intensional objects of some sort, that the failed entailment between "know the capital of" and "know the largest town in" resembles the failed "ninety is rising" entailment. Once we adopt Lasersohn's suggestion that no common noun denotes a set of individual concepts, we lose the lexical intensionality of *price* and *temperature*, and thereby also lose the ability to distinguish, based on the types of their denotations, *price* and *temperature* from *picture* and *semanticist*. At that point, any attempt at all to explain why the former but not the latter form CQs without further modification becomes much harder. For instance, the type-shifting operation in the last chapter that turned DPs into question-denoting objects, repeated here,

(57) $\langle s, e\rangle \rightarrow \langle st, t\rangle$
$\lambda x_{se} . \lambda p_{st} . [\exists y_e . p = \lambda w_1 . [x(w_1) = y]]$

---

[29] One could try to salvage Romero's approach by separating worlds and times instead of grouping them into a single index. (I am grateful to Irene Heim (p.c.) for bringing this to my attention.)

That is, individual concepts could be considered functions from *times* to individuals, suitable for being the subject of *rise* or *change*; whereas concealed questions would be functions from *worlds* to individuals. Distinguishing the two kinds of index as s_w for worlds and s_t for times, *rise* and *change* would have the semantic type $\langle\langle s_t, e\rangle, t\rangle$, and $know_{CQ}$ and $tell_{CQ}$ would have the semantic type $\langle\langle s_w, e\rangle, et\rangle$. Lasersohn's method of creating ICs would thereby involve lambda-abstraction over a time index, creating a semantic object unsuitable to be the object of *know*, *tell*, etc. This would additionally explain the data in (35), in which a single DP cannot be both an IC and a CQ.

However, this approach faces a number of difficulties. First, some nouns would need to have $\langle\langle s_w, e\rangle, t\rangle$ denotations for CQ uses in addition to their $\langle e, t\rangle$ denotations for common-noun uses (this latter denotation also being needed for intensionalization over times to create an IC). Like Heim (1979), we might still be concerned that this ambiguity extends to practically every noun in the lexicon. The shifting operations discussed in the next chapter could solve this problem, though in any case something more would need to be said.

Second, once worlds and times are separated, it becomes surprising that we have lexical items which select for $\langle s_t, e\rangle$ subjects but not $\langle s_w, e\rangle$ subjects. And third, given Lasersohn's method of deriving $\langle s_t, e\rangle$ objects from any definite description by abstracting over the time-index variable, the grammar should allow abstraction over a world-index variable to derive a $\langle s_w, e\rangle$ object from any definite description. If it does, we find ourselves right back where we started, without a way to distinguish possible CQs from impossible ones. These two problems seem less easy to overcome, suggesting that, while splitting worlds and times might resolve some of the challenges to a theory of ICs as CQs, the move is unlikely to be correct.

also can no longer distinguish *the temperature* from *the picture* and generates question denotations from either with equal ease.

Circumventing this lack of distinction will be a central concern of the next chapter. We will, at least, have an advantage over the theory that concealed questions are individual concepts: by finding another type for the object argument of a CQ-embedding predicate, we can find a type-driven explanation for some DPs, but not others, being able to fill that argument position. A theory in which that argument has the type $\langle s, e\rangle$ must find some other mechanism to distinguish the two kinds of DPs; and no other mechanism is readily apparent.

3.5. Summary

At this point, we have a number of different uses for DPs requiring at least three different denotations—individuals, individual concepts, and a concealed question denotation which is neither of these. We now have the background necessary to propose a new theory of CQ denotations, one that relates all three of these DP meanings. In the next chapter, we will see this theory and consider how to achieve the right meanings compositionally, as well as deriving the Proposition/Concealed Question Correlation as a consequence.

3.5.1. A final word about worlds, times, and world/times

Throughout this chapter, I have spoken of individual concepts (and, by extension, Romero's meaning for concealed questions) as functions from world/time indices to individuals. At a few points, I have alluded to a possible response from a defender of Romero's approach: separating worlds and times. That is, individual concepts could be considered functions from *times* to individuals, suitable for being the subject of *rise* or *change*; whereas concealed questions would be functions from *worlds* to individuals.[30]

Distinguishing the two kinds of index as s_w for worlds and s_t for times, *rise* and *change* would have the semantic type $\langle\langle s_t, e\rangle, t\rangle$, and $know_{CQ}$ and $tell_{CQ}$ would have the semantic type $\langle\langle s_w, e\rangle, et\rangle$. Lasersohn's method of creating ICs would thereby involve lambda-abstraction over a time index, creating a semantic object unsuitable to be the object of *know*, *tell*, etc.; and Romero's CQ meanings, as in (12), would involve lambda-abstraction over a time index. This would additionally explain the data in (35), in which a single DP cannot be both an IC and a CQ, and provides a starting point for distinguishing those DPs that can be ICs (i.e., nearly all of them) from those that can be CQs (i.e., only a fraction of them).

However, this approach faces a number of difficulties. First, some nouns would need to have $\langle\langle s_w, e\rangle, t\rangle$ denotations for CQ uses in addition to their $\langle e, t\rangle$ denotations for common-noun uses (this latter denotation also being needed for intensionalization over times to create an IC). Like Heim (1979), we might still be concerned that this ambiguity extends to practically every noun in the lexicon. The shifting operations discussed in the next chapter could solve this problem, though in any case something more would need to be said.

Second, once worlds and times are separated, it becomes surprising that we have lexical items which select for $\langle s_t, e\rangle$ subjects but not $\langle s_w, e\rangle$ subjects. And third, given Lasersohn's method of deriving $\langle s_t, e\rangle$ objects from any definite description by abstracting over the time-index variable, the grammar should allow abstraction over a world-index variable to derive a

[30] I am grateful to Irene Heim (p.c.) for bringing this to my attention.

$\langle s_{w'}, e \rangle$ object from any definite description. If it does, we find ourselves right back where we started, without a way to distinguish possible CQs from impossible ones. These two problems seem less easy to overcome, suggesting that, while splitting worlds and times might resolve some of the challenges to a theory of ICs as CQs, the move is unlikely to be correct.

CHAPTER 4: WHY CONCEALED QUESTIONS DENOTE PROPOSITIONS

Having seen a number of denotations that make the wrong predictions about concealed questions, with regard to either what they mean, which predicates allow them as complements, or which DPs can serve as them, we are ready to find a theory to encompass all three.

In the two primary theories of concealed question meaning we have examined, CQs denoted questions and individual concepts. This chapter argues that CQs denote propositions, roughly like the one in (1b).

(1) a. $\lambda p_{st}\,.\ \exists x_e\,.\,p = [\lambda w_1\,.\,x = \text{THE-PRICE-OF-MILK}(w_1)]$
b. $\iota p_{st}\,.\ \exists x_e\,.\,p = [\lambda w_1\,.\,x = \text{THE-PRICE-OF-MILK}(w_1)]$

Recall that the question denotation in (1a) seemed to be adequate semantically, and only ran into trouble with the distribution of CQs. The proposition denotation in (1b) bears an obvious similarity to the question denotation, which suggests that the latter also stands a good chance of capturing the semantic facts. And because the proposition denotation (like the question denotation) incorporates the $\langle s, e\rangle$ meaning of *the price of milk*, we should be able to derive the CQ meaning of a DP (i.e. the propositional meaning) from the IC meaning, which we know must exist for the independent reasons discussed in the previous chapter.

Before we blithely and wholeheartedly adopt (1b) as the CQ denotation of *the price of milk*, a few observations are in order. First, if we derive the propositional meaning from the IC meaning—either directly via a type-shifting operation like the one proposed in Chapter 2 to derive the question meaning from the $\langle s, e\rangle$ denotation, or indirectly via the question meaning—then our theory will be open to the same challenge seen in previous chapters: every DP, apparently, can receive an IC denotation, but not all of them can become CQs. And second, the meaning in (1b) is not quite right: there is no unique proposition p such that, for some x, p expresses that x is the price of milk in w_1. In fact, even if we limit possible prices to integers, there are an infinite number of such propositions, one for each integer x.

Therefore, rather than plunge immediately into the ramifications of the theory that CQs denote propositions, let us go through some necessary prior steps which will derive the correct propositional meanings, in a compositional manner and only for the correct subset of DPs. In §4.1, we will consider how exactly to characterize this subset of DPs by distinguishing different categories of noun. §4.2 revisits the individual concept, beginning with the conclusions of Lasersohn (2005) and demonstrating in §4.2.1 that, while $\langle se, t\rangle$ denotations may not be necessary as lexical meanings of nouns, they cannot be eliminated entirely. The subsections following consider each category of noun proposed in the opening section, showing what lexical types they have and how to derive a meaning of type $\langle se, t\rangle$ for each.

Once we have the necessary semantic types for the various categories of noun, we move on to deriving the propositional meanings proposed for CQs. In §4.3, we will once again consider the categories of noun and see how propositional meanings can be derived for those, and only those, DPs that can be CQs. We will also see, once we have derived meanings more subtle than the one in (1b), that propositions capture the correct range of meanings for CQs. Chapter 5 will once again take up the issue of CQ distribution and the PCQC.

4.1. Relational Nouns and Nonrelational Nouns

Much of the previous CQ literature discusses determiner phrases containing only a head noun with a complement, but which have no adjunct or modifying adjective.[1] A partial list, based on Caponigro and Heller (2003):

(2) Tell me...

the *governor* of California	the *winner* of last year's Pulitzer Prize
the *outcome* of the trial	the *capital* of Vermont
the *location* of the meeting	the *color* of my eyes
your *shoe size*	your *height*
the *price* of milk	the *time* of the meeting
the *temperature* of the water	Bill's *telephone number*
the *square root* of 49	the *sum* of 8 and 9

Caponigro and Heller categorize these as *functional nouns*, nouns that denote functions from individuals to individuals—that is, objects with type $\langle e, e\rangle$. On this view, *capital* (or perhaps *the capital of*) is a function from a country (state, province, etc.) to a particular city, *sum* from a plurality of numbers to a number, *governor* from a state to a person, and so forth.

I will depart from them in terminology and use the term *relational nouns* (RNs), as the relation expressed may not always be strictly a function, i.e. a one-to-one mapping. For instance, *color* relates an object to that object's colors, but a single object may have more than one color. Similarly, some countries have more than one capital, such as Bolivia, which the *capital* relation maps to both La Paz and Sucre. A relational noun denotes an object with type $\langle e, et\rangle$: for instance, $[\![capital]\!]$ maps Italy to the set of things that are a capital of Italy, namely {Rome}, and similarly maps Bolivia to the set {La Paz, Sucre}. A definite determiner is pragmatically appropriate only when the sets are singleton sets—that is, when the relation is one-to-one, which is to say a function. (It is occasionally convenient to speak of these nouns as if they do denote $\langle e, e\rangle$ objects that map individuals to individuals, though when working with the compositional meanings we must be careful not to use this informal sense.) When the relation is not one-to-one, an indefinite determiner is more appropriate: *Blue is a color of the rainbow*.[2]

One goal of this chapter will therefore be to find a mechanism to derive propositional denotations from the lexical meanings of relational nouns. But before we move on, let us expand on the qualification that begins this section: though much of the previous CQ literature focuses on those with relational nouns, not all of it does. Recall that Heim (1979) discusses some CQs with other nouns (NRNs, or nonrelational nouns) as their heads: *everything John did* and *John's favorite drink* in particular sparked her concern that, in a CQs-as-ICs theory, every noun in the

[1] The argument of the head noun is required semantically; syntactically, the argument may be realized as an actual complement (*the governor of California*) or as a genitive (*your height* ≡ *the height of you*), or may, in certain particular circumstances, be implicit (*the temperature* ≈ *the temperature of the current setting*).

[2] Another reason to use "relational noun" instead of "functional noun" is that, as we saw in the last chapter, Löbner (1981) uses the latter term very differently, as a translation of the term *Funktionalbegriffe* from Löbner (1979). *Funktionalbegriffe* seems to refer to nouns denoting functions from world/time indices to individuals—that is, expressions usually called "individual concepts". See §3.3.2 for further discussion.

Not all relational nouns form CQs: those expressing relationships between people, in particular, seem degraded to me. I find *Tell me her mother* very odd; even when the mother is someone famous or relevant, e.g. *I know Liza Minnelli's mother—it's Judy Garland*, it seems strange at best to me. This is an issue I will set aside.

lexicon might need to be exempt from Montague's meaning postulate on extensional nouns. (Heim also discusses *the largest town in Italy*, and mentions *everyone's favorite movie* in a point about CQ meanings not arising from the DP taking narrow scope.) Implicit in this concern is the assumption that nonrelational nouns (*thing*, *drink*, *town*, *movie*) obtain CQ denotations in the same manner as relational nouns, either by having the same exemption from the extensional meaning postulate, or by having the same lexical semantic type (if nouns can have either $\langle e, t\rangle$ and $\langle se, t\rangle$ denotations lexically).

A second goal of this chapter will be to challenge this assumption. An RN needs nothing more than its complement and a definite determiner to form a CQ—or at least nothing else overt. An NRN, on the other hand, must have some additional structure, present in the possible CQs *the semanticist who teaches at USNDH* and *the largest city in Vermont* but not in DPs that cannot be CQs like *the USNDH semanticist* or *the large city in Vermont*. We will return to this fact in §4.3.2, which considers what additional structure can or cannot produce CQs from NRNs and suggests how this structure might produce propositional meanings.

To help differentiate RNs from NRNs in their respective capacities as the heads of CQs, the next section revisits the question of IC meanings. Last chapter we saw how Lasersohn separated relational nouns like *temperature* and *price* from individual concept denotations, giving all nouns, RN and NRN alike, lexical denotations of type $\langle e, t\rangle$. The next section reconsiders the completeness of that separation in order to re-establish a lexical distinction between RNs and NRNs.

4.2. Individual Concept Meanings Rederived

Lasersohn (2005) eliminated type $\langle se, t\rangle$ denotations from the lexicon, demonstrating that even for nouns that can head a DP subject of *rise*, an $\langle e, t\rangle$ denotation is sufficient. In this section, we will see that $\langle se, t\rangle$ denotations cannot be eliminated entirely from the interpretation process, but that they can be derived as necessary and, as Lasersohn hoped, need not be stored lexically. By seeing how relational and nonrelational nouns differ in their ability to have $\langle se, t\rangle$ denotations, we will be able to once again differentiate them by lexical semantic type, a crucial step in deriving CQ denotations for the former and not the latter.

4.2.1. Quantified individual concepts

In §3.4.1, we saw that Lasersohn removed the need for $\langle se, t\rangle$ denotations by making the definite determiner presuppositional and not quantificational. Lasersohn correctly observed that the original motivation for having *temperature* and *price* denote sets of individual concepts was the need for *the* to be able to quantify over the elements in such a set, and he removed that need.

But what happens when ICs are put into contexts where that sort of quantification really is needed—for instance, with an actual quantifier? Consider the truth conditions for the following sentences, one with a relational noun and one with a nonrelational noun.[3] (The first

[3] *Picture* is not, I believe, a relational noun in spite of its ability to take an internal argument, e.g. *the picture of Richard Nixon*; my intuition is that the argument of *picture* does not bear the same relation to the picture that, for instance, the argument of *governor* bears to the governor. I find it implausible to think of *picture* as mapping an individual to the set of pictures of him, as opposed to *governor* mapping a state to the set of its governors.

sentence happens to be false, but we can easily imagine the circumstances under which it would be true.)

(3) a. (In the 2004 election in the U.S.,) every governor changed.
b. (Each month,) every picture on Jordan's wall changes.

As *every governor* and *every picture on Jordan's wall* do not denote sets of individuals, the sets of governors before and after 2004 cannot merely be different sets, e.g. by replacing one member of the set with a new member (and similarly for the sets of pictures). At a first approximation, the sentences in (3) are true only if each one of the individual governors or pictures changed—that is, if the entire set of governors was replaced in 2004 by a new set of governors, and if the set of pictures on Jordan's wall is replaced each month by an entirely new set. Additionally, the two sets must be the same size. For (3a) this may seem like a merely pragmatic necessity, but (3b) is not true if this month Jordan took down three pictures by Escher and put up six by Picasso, though nothing in the situation is implausible. There is an intuition that the change must occur to each picture.[4]

We might try to extend Lasersohn's analysis of definite descriptions to quantificational DPs in a naïve and straightforward way. Like definite descriptions, both quantificational DPs in (3) have purely extensional uses, for which they denote $\langle et, t\rangle$ objects. For instance, the subject of (4a) has the familiar composition in (5).

(4) a. Every governor voted for himself or herself.
b. Every picture on Jordan's wall depicts a horse.

(5) $[\![every]\!] = \lambda P_{et} . \lambda Q_{et} . \forall x_e . P(x) \rightarrow Q(x)$ $\langle et, \langle et, t\rangle\rangle$
$[\![governor]\!] = \lambda x_e . \text{governor}(x)$ $\langle e, t\rangle$
$[\![every\ governor]\!] = [\![every]\!]([\![governor]\!]) =$
$\lambda Q_{et} . \forall x_e . \text{governor}(x) \rightarrow Q(x)$ $\langle et, t\rangle$

If Lasersohn is correct that nouns translate only to objects of type $\langle e, t\rangle$ (whether nonrelational nouns or, presumably, relational nouns in this usage), then *every governor* in (3a) denotes the same object of type $\langle et, t\rangle$ as it does in (4a). This meaning, however, cannot compose with the $\langle se, t\rangle$ predicate *change*. Therefore, just as *the governor* has a type-e denotation which can

---

Consider as well that the complement of a relational noun can also appear as a possessive: *California's governor, the water's temperature, the trial's outcome*, in addition to those in (2) already expressed as possessives. On the other hand, *Richard Nixon's picture* can, for me, only very marginally refer to a picture depicting Nixon as opposed to one he owns; *Rouen Cathedral's picture* cannot refer to a Monet painting even marginally.

For those who do not share my intuition and rather sensibly decide not to take my word for it, "picture on Jordan's wall" can be replaced with "chair in Jordan's office" without changing the judgments. I hope even the most skeptical reader, first, will agree that *chair* takes no internal argument, and, second, will indulge my continuing to use *picture*, as pictures are pragmatically more likely than chairs to be things that change on a monthly basis.

[4] Note that these intuitions do not hold for a definite plural DP, such as *the governors changed* or *the pictures on Jordan's wall change*. Replacing only some governors with new ones makes the former true; Jordan taking down three pictures and putting up six new ones is compatible with the latter.

The DPs in these sentences denote a single unique plurality of individuals (i.e. the maximal plurality), intensionalized à la Lasersohn, of which *change* is asserted to be true. Changing some of the individuals in the set changes the maximal plurality, and nothing requires the pluralities to have the same cardinality. In general, we would expect different judgments with *the NPs* or other determiners with plural nouns than with *every NP*.

intensionalize to a type-$\langle s, e\rangle$ denotation, we can intensionalize *every governor* to have an $\langle s, \langle et, t\rangle\rangle$ denotation.

This denotation also cannot compose with an $\langle se, t\rangle$ predicate. However, *change* could have different types for differently-typed subjects, because it typeshifts or because it is lexically type-neutral. Then, in addition to the $change_{\langle se, t\rangle}$ used for $\langle s, e\rangle$ subjects formed by intensionalizing type *e* objects, we could predicate a $change_{\langle\langle s, \langle et, t\rangle\rangle, t\rangle}$ of the intension of the $\langle et, t\rangle$ denotation of *every governor*.

(6) $[\![every\ governor]\!] = \lambda t . \lambda Q_{et} . \forall x_e . (x \text{ is a governor at } t) \rightarrow (Q(x) \text{ at } t)$ $\langle s, \langle et, t\rangle\rangle$
$[\![changes]\!]^t = \lambda A_{\langle s, \langle et, t\rangle\rangle} . \exists t_1 < t . [A(t_1) \neq A(t)]$ $\langle\langle s, \langle et, t\rangle\rangle, t\rangle$
$[\![every\ governor\ changes]\!]^t = \exists t_1 < t . [$
$[\lambda Q_{et} . \forall x_e . (x \text{ is a governor at } t_1) \rightarrow (Q(x) \text{ at } t_1)] \neq$
$[\lambda Q_{et} . \forall x_e . (x \text{ is a governor at } t) \rightarrow (Q(x) \text{ at } t)]$ $]$

According to this last formula, *every governor changes* asserts that the extension of the set of properties true of every governor at different times is different. But these are not the correct truth conditions, as replacing a single governor with a new governor would suffice for this to be true. In fact, the set of properties true of every governor might change if the set of individuals who are governors doesn't change at all, by changing a property of even a single governor. For instance, if in January all governors are unmarried and one governor gets married in February, then the set of properties true of every governor includes the property denoted by *unmarried* in January but not in March, and thus the truth conditions expressed in (6) are met. Nevertheless, these changes are not sufficient to meet the truth conditions of *every governor changes*.

Instead, based on the intuition that each governor must be replaced by a new governor, it seems that the $\langle se, t\rangle$ sense of *change* must hold for each member of a set of individual concepts. The sentence should paraphrase as *for every* x_{se} *where* x *is a governor,* x *changes (i.e. has different values at different times)*; and for "where x_{se} is a governor" to make sense, *governor* needs to have an $\langle se, t\rangle$ denotation. With this denotation available, the quantifier relates two sets of ICs, the set denoted by *governor* and the set denoted by *change*. This is exactly the structure that Montague posited for *the temperature rises*: after all, it was sentences of exactly this form—sentences that seem to need a $\langle\langle se, t\rangle, \langle\langle se, t\rangle, t\rangle\rangle$ denotation for the determiner—that motivated Montague to give common nouns $\langle se, t\rangle$ denotations. And easy as it is to write a meaning in which the set of governors ICs relates to the set of ICs that change...

(7) $\forall x_{se} . \text{governor}(x) \rightarrow [\exists t_1 < t . [x(t_1) \neq x(t)]\ ]$

...it forces us to retreat from one interpretation of Lasersohn's position: *governor* must denote a set of individual concepts. But Lasersohn need not be read as arguing against the existence of sets of individual concepts; his statement that "common nouns receive translations of type $\langle e, t\rangle$ rather than $\langle se, t\rangle$" (p. 132) may mean only that common nouns are never listed lexically as such sets. This leaves open the possibility of deriving a set of individual concepts.

4.2.2. Deriving ICs from relational nouns

As a quantificational DP can be used as an IC regardless of whether its head noun is relational or nonrelational, we will need an analysis that works for either one. This section begins by focusing on relational nouns, after which we will see ways in which nonrelational nouns differ empirically from relational nouns and extend the analysis appropriately.

4.2.2.1. Attempt one: deriving a set of ICs from (the intension of) the set of individuals

We have seen that there is a type ambiguity in quantified DPs, one that follows from an apparent ambiguity in common noun denotations. That is, *picture (on Jordan's wall)* can either denote an object with type $\langle e, t\rangle$, which we will follow Lasersohn in assuming to be the lexical denotation of a common noun, or a derived object with the type $\langle se, t\rangle$. Similarly, *every governor* may denote an $\langle et, t\rangle$ object, suitable to be the subject of an extensional verb (such as *votes*) to express that every individual who is a governor also has the property denoted by the verb. And it may also denote an object of type $\langle\langle se, t\rangle, t\rangle$, combining with an intensional verb (such as *change*) to express that every individual concept which is, in some way, a governor has the property denoted by the verb.

Lasersohn derived the IC denotation of a DP by intensionalizing its type-*e* denotation. We saw that an analogous derivation from the quantified DP does not work and that we need to change the meaning of the noun. The simplest continuation of Lasersohn's approach might be to derive the "set of individual concepts" denotation of *governor* from its lexical "set of individuals" denotation. Of course, we would actually need the intensions of the set, as the extension of a set of individuals does not contain enough information to allow the grammar to construct individual concepts out of the individuals. However, given the extension of the set at each possible world, the grammar can create individual concepts whose extension in each world is a member of the set's extension in that world. This latter criterion for δ, a set of individual concepts, derived from P, an intension of a set of individuals, can be expressed:

(8) $\forall x_{se} \in \delta\ .\ [\forall w\ .\ \mathrm{P}(w)(x(w)) = 1]$

That is, every individual concept *x* in the set should be such that, in all worlds *w*, the individual that is the value of *x* in *w* should be in the extension of P in *w*. (For instance, every individual concept in the $\langle se, t\rangle$ denotation of *governor* should, when evaluated at any world *w*, return an individual in the $\langle e, t\rangle$ denotation of *governor* in world *w*.)

This condition is necessary; but it isn't sufficient. Consider *governor* when it denotes a set of individuals, as in *every governor votes*. What individual concepts might we expect to have in the set of ICs denoted by *governor*? Let's use small models containing only two indices (e.g. (*2002 in* w_0 and *2005 in* w_0—henceforth we will omit the world part of the index) and at most twelve individuals who are governors, six at each index. As we'd like to derive the set of individual concepts from the intension of the set of individuals, we'll start with the latter.

(9) $[\![governor]\!]_{\langle s, et\rangle}$ =
[2002 → {Rowland, King, Swift, Benson, Almond, Dean},
2005 → {Rell, Baldacci, Romney, Lynch, Carcieri, Douglas}]

The six governors listed in each of the sets are the governors of the New England states Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont, in that order, for their respective years.

Now here are two sets of individual concepts that meet the criterion in (8):

(10) a. { [2002 → Rowland, 2005 → Rell], [2002 → King, 2005 → Baldacci],
[2002 → Swift, 2005 → Romney], [2002 → Benson, 2005 → Lynch],
[2002 → Almond, 2005 → Carcieri], [2002 → Dean, 2005 → Douglas] }

b. { [2002 → Rowland, 2005 → Lynch], [2002 → King, 2005 → Romney],
[2002 → Swift, 2005 → Carcieri], [2002 → Benson, 2005 → Baldacci],
[2002 → Almond, 2005 → Douglas], [2002 → Dean, 2005 → Rell] }

In each set, every individual concept denotes a 2002 governor when evaluated for 2002, and a 2005 governor when evaluated for 2005. Nevertheless, there is a very real sense in which the ICs in the set in (10a) are governor-ICs and the ICs in the set in (10b) are not. The difference is that the latter assignments are arbitrary, whereas the former follow a pattern: the individual concept that maps 2002 to John Rowland and 2005 to M. Jodi Rell is the individual concept whose value at each world/time is the governor of Connecticut, and so forth.

Producing a nonarbitrary set of ICs makes deriving the set harder; it's also essential to the truth conditions. Let's use a new, hypothetical model with indices *2005* and *2007*. Suppose that each of the six New England governors has a term ending in 2006. Each runs for re-election and wins. Both of the following sets satisfy (8), in that each IC in each set picks out a 2005 governor for 2005 and a 2007 governor for 2007.

(11) a. { [2005 → Rell, 2007 → Rell], [2005 → Baldacci, 2007 → Baldacci],
[2005 → Romney, 2007 → Romney], [2005 → Lynch, 2007 → Lynch],
[2005 → Carcieri, 2007 → Carcieri], [2005 → Douglas, 2007 → Douglas] }

b. { [2005 → Rell, 2007 → Baldacci], [2005 → Baldacci, 2007 → Rell],
[2005 → Romney, 2007 → Lynch], [2005 → Lynch, 2007 → Romney],
[2005 → Carcieri, 2007 → Douglas], [2005 → Douglas, 2007 → Carcieri] }

In the scenario described above, (12) is true: every New England state kept the same governor after the 2006 election.

(12) In New England, no governor changed.

However, while taking (11a) to be the set of ICs denoted by *governor* makes the sentence true, taking *governor* to denote (11b) makes the sentence false. In the latter case, it is not true that for no individual concept in the set are there two different times such that the value of the IC at the two times is different. On the contrary, every IC in the set meets that criterion; we might predict on the basis of this set that *every governor changed* is true, which it is not.

But suppose that, instead of running for re-election at the end of their terms, all six New England governors realize that the voters in their own states will never re-elect them, but that they have strong support in other states. Consequently, Governor Rell decides not to run for re-election in Connecticut, but instead buys a house in Maine and runs for governor there; meanwhile, Governor Baldacci of Maine buys a house in Hartford and runs for governor of Connecticut; and similarly for the other four states. All six win the gubernatorial race in their new home states. Now we do want a set of ICs which permutes the governors—in fact, a set exactly like (11b). This set will still make (12) false and *every governor changed* true, but in this new circumstance, these are the correct judgments for these sentences.

Therefore, we cannot let our grammar use any arbitrary set of ICs that satisfies (8). At the same time, we do not want set a requirement that each IC must select the same member of each set if possible, which would incorrectly prevent permutations in those situations where a permutation is desired.[5]

We could make (8) stronger and require it to include *all* individual concepts that meet the criterion. In other words, we could have the type-shifting operation:

(13) $\lambda P_{\langle s, et\rangle} . \lambda x_{se} . [\forall w . P(w)(x(w)) = 1]$

This produces a larger set of ICs: instead of having six governor-ICs in it, the set derived by (13) has thirty-six. Taking a more manageable model that contains only Jodi Rell, John Lynch, and Donald Carcieri, and returning to the scenario in which each wins re-election in 2006 in their own states, the shifting operation in (8) produces the set:

(14) { [2005 → JR, 2007 → JR], [2005 → JR, 2007 → JL], [2005 → JR, 2007 → DC],
[2005 → JL, 2007 → JR], [2005 → JL, 2007 → JL], [2005 → JL, 2007 → DC],
[2005 → DC, 2007 → JR], [2005 → DC, 2007 → JL], [2005 → DC, 2007 → DC] }

Though the quantifier in *every governor* seems to quantify over a set with three ICs for this model, we derive a set with nine, each of which maps each index to an individual who's a governor at that index. The problem here, however, does not concern intuitions about the cardinality of the set; the problem is that this set also gives us the wrong result for the truth conditions of (12): *change* is true of six of the nine ICs in the set, and therefore using the nine-IC set to evaluate *no governor changed* will again incorrectly predict that the sentence is false.

The key for the relational noun *governor* is that the ICs that ought to be in the $\langle se, t\rangle$ denotation are not all ICs nor some arbitrary ICs, but only those that correspond to the states of which the governors are governor. Though we derived the above sets from the intension of the set of individuals who are governors, an individual cannot be a governor without being the governor of *something*—which is to say, *governor* is a relational noun with an $\langle e, et\rangle$ meaning in addition to its $\langle e, t\rangle$ meaning. The individual concepts must also each have something they are, in some sense, governors of. We want the IC *[2002 → Rowland, 2005 → Rell]* in the set of ICs denoted by *every governor* because this IC represents a single governorship; it's the IC *the governor of Connecticut*. In contrast, *[2002 → Rowland, 2005 → Lynch]* has no individual *x* such that *the governor of x* names it.

What we need to limit the type-shifting operation is a reference to the argument position of the relational noun, so that the set of ICs derives from the $\langle e, et\rangle$ meaning and not the $\langle e, t\rangle$

[5] ICs with relational nouns such as *governor* should not disallow permutations, at any rate. Permutations with common nouns such as *picture* will be discussed in §4.2.4.

Another reason not to pick an arbitrary set of ICs is that the task gets harder with more individuals or indices; the number of possible sets grows quickly. With six governors and two indices, there are 6! = 720 sets of six individual concepts. Adding a third world/time index turns those 720 sets into $(6!)^2$ = 518,400 sets. With fifty governors, the grammar would have to pick one set out of 50! ≈ 3 x 10^{64} possibilities for two indices; and *representative* (i.e. member of the U.S. House of Representatives) yields 435! ≈ 3.5 x 10^{960}, or somewhat more than a googol cubed cubed, possible $\langle se, t\rangle$ denotations with cardinality 435.

meaning. In subsequent sections, we will see how this can be done, and later we will use the $\langle e, et\rangle$ vs. $\langle e, t\rangle$ distinction to derive CQ denotations; as a basis for these derivations, let us pause to consider the status of this argument position.

4.2.2.2. The role of the argument position in relational nouns

In *every/no governor*, the argument position is not filled overtly. Using an object with a type *e* denotation as the complement will produce an anomalous DP—because a state has only one governor and an object has (in our somewhat simplified model) only one price, DPs such as *every governor of Massachusetts* or *every price of milk* have the same anomaly as any other universal quantification over a singleton set.[6] However, the position can in theory have a second quantified DP.

In general, quantifiers within DPs have two possible scope positions. They can scope outside the DP, as in the most natural reading of the sentence in (15), given in the rough semantic translation below it.

(15) An applicant from every European country was accepted to the program.
$\forall y_e$. [european-country(y) $\rightarrow$ [$\exists x_e$. applicant-from(y)(x) $\wedge$ x was accepted]]

Or they can scope within the DP, attaching under the determiner (see Heim and Kratzer 1998, Chapter 8, for compositional details):

(16) Every applicant from a European country was accepted to the program.
$\forall x_e$. [[$\exists y_e$. european-country(y) $\wedge$ applicant-from(y)(x)] $\rightarrow$ x was accepted]

Generally speaking, either scope should be possible unless ruled out pragmatically (for instance, (15) has the possible but extremely unlikely reading that there is an applicant *x*, where *x* is from *y* for every European country *y*, who was accepted; (16) has the possible but somewhat less salient reading that, for some European country *y*, every applicant from *y* was accepted).

With relational nouns, having the argument scope out of the DP is unproblematic, regardless of whether the NP denotes a set of individuals or a set of individual concepts. With a set of individuals:

(17) a. The governor of every New England state ran for re-election.
b. The price of every dairy product is divisible by seven.

These sentences mean, as one might expect, that for every New England state *y*, the governor of *y* ran for re-election (not a property of functions, but a purely extensional property of the individual governors) and that for every dairy product *y*, the price of *y* is higher than the price of sugar (again, an extensional property true of the individuals). And with a set of individual concepts and the intensional predicate *change*:

[6] Such DPs are anomalous specifically when quantifying over ICs, as in the last section. They can be used felicitously when *governor of Massachusetts* denotes a non-singleton set of individuals, as for instance when discussing governors of Massachusetts throughout its history (*Every governor of Massachusetts has been someone born in the state*).

(18) a. The governor of every New England state changed.
b. The price of every dairy product changed.

These sentences, too, have the expected meanings. The former, for instance, can be represented as (19),

(19) $\forall y_e \,.\, [\text{NE-state}(y) \rightarrow \text{change}(\lambda w_1 \,.\, [\iota x_e \,.\, x \text{ is a governor of } y \text{ at } w_1])]$

with the type-*e* denotation of *the governor of y* intensionalized to turn it into an individual concept, following Lasersohn.

However, trying to scope the embedded DP under the determiner produces different judgments. Extensionally, RNs allow their arguments to take lower scope:

(20) a. Every governor of a New England state ran for re-election.
b. Every price of a dairy product is divisible by seven.

These sentences are synonymous with their counterparts in (17). But when used intensionally, RNs disallow this lower scope.

(21) a. ?#Every governor of a New England state changed.
b. #Every price of a dairy product changed.

We might expect these sentences to be equivalent to those in (18), as the lower-scope reading of (20a) would be paraphrased as *Every* x, *where there's a NE state* y *and* x *is the (intensional) governor of* y, *changed*, and similarly for (20b). Nevertheless, they are infelicitous.

Of course, the unacceptability of these sentences cannot result from an incompatibility of a quantifier with a set of individual concepts, as we have seen that a determiner can quantify over a set of ICs. In fact, the meanings that these sentences fail to express can be expressed with a quantification over ICs that does not fill the argument position of the relational noun. Restricting the domain of the noun contextually instead of with an overt argument produces acceptable sentences, as does using a pronoun (e.g. by paraphrasing the DP as *all of them*):

(22) a. Chris thinks he knows {the price of every dairy product/the governor of every New England state}, but recently, **all of them changed**.

b. Chris thinks he knows the price of every item in the store, but **in the dairy section, every price changed** after yesterday's milk shortage announcement.

c. Chris thinks he knows the governor of all fifty states, but **in New England, every governor changed** after yesterday's election.

The problem must occur when the argument position is filled—indeed, nonrelational noun phrases, which have no argument position to fill overtly, are acceptable as subjects of either intensional or extensional verbs, as we saw earlier in this section (*Every applicant from a European country...* demonstrated the extensional fact, and *every picture on Jordan's wall...*, the intensional).

Let us consider the conceivable but not actually possible interpretation of *every governor of a New England state changed* (and *every price of a dairy product changed*). If we try to write a logical form analogous to the paraphrase given above for *every applicant from a European country*, we would have:

(23) $\forall x_{se}$. [[$\exists y_e$. new-england-state(y) $\wedge$ governor-of(y)(x)] $\rightarrow$ x changed]

The variable x must range over individual concepts and not over individuals; consequently, *governor-of(y)* must be a property of ICs. In that case, *governor* would have, among its denotations, something like the following.

(24) $[\![governor]\!]_{\langle e, \langle se, t\rangle\rangle} = \lambda y_e . \lambda x_{se} . \forall w . x(w)$ is a governor of y in w

The infelicity of *Every governor of a New England state changed* suggests that *governor* cannot have this meaning, and more generally that relational nouns cannot have $\langle e, \langle se, t\rangle\rangle$ denotations.

This conclusion has important consequences for the current objective of incorporating the argument of the relational noun into the derivation of the $\langle se, t\rangle$ meaning. Though we want to include the state governed in the derivation of the ICs in the denotation of *governor*, we do not want *governor* to be a function from states to the sets of ICs that represent their governors, as in the meaning in (24). In other words, though we might (and, in a moment, will) derive $governor_{\langle e, t\rangle}$ from $governor_{\langle e, et\rangle}$ so that the former set reflects the internal argument present in the latter denotation, we do not want to derive $governor_{\langle se, t\rangle}$ from a $governor_{\langle e, \langle se, t\rangle\rangle}$ meaning.

Nevertheless, the argument position of the relational noun must play some role in the derivation of the set of ICs. In the next section, we begin to derive the desired meanings within these constraints.

4.2.2.3. Attempt two: deriving ICs from a relational noun

The previous two sections demonstrated that the grammar does not derive $\langle se, t\rangle$ denotations for relational nouns from $\langle e, t\rangle$ or $\langle e, \langle se, t\rangle\rangle$ meanings. In this section, we return to the intuition that *governor* and other relational nouns denote $\langle e, et\rangle$ objects, where the noun takes an individual as an argument—e.g., a state—and returns a set of individuals—e.g., the individuals who are governors of that state.[7] The extension of *governor* in 2005 at w_0 (i.e. the actual world at the time of writing) maps *Connecticut* to the singleton set {M. Jodi Rell}, the only individual who is a governor of Connecticut; it maps *Massachusetts* to {Mitt Romney}, and so forth. Its intension, on our limited model, is as follows.

[7] The function may return the empty set: for instance, $[\![$*governor of MIT*$]\!]$ = { }, because MIT has no governor (it has a president, and deans, and so forth). *Governor of MIT* has the same status as *unicorn* in the grammar: *the governor of MIT* fails to refer, *There is no governor of MIT* is true, and so forth.

$$(25) \quad [\![governor]\!]_{\langle s, \langle e, et\rangle\rangle} = \begin{bmatrix} 2002 \rightarrow \begin{bmatrix} \text{CT} \rightarrow \{\text{Rowland}\} & \text{NH} \rightarrow \{\text{Benson}\} \\ \text{ME} \rightarrow \{\text{King}\} & \text{RI} \rightarrow \{\text{Almond}\} \\ \text{MA} \rightarrow \{\text{Swift}\} & \text{VT} \rightarrow \{\text{Dean}\} \end{bmatrix} \\ 2005 \rightarrow \begin{bmatrix} \text{CT} \rightarrow \{\text{Rell}\} & \text{NH} \rightarrow \{\text{Lynch}\} \\ \text{ME} \rightarrow \{\text{Baldacci}\} & \text{RI} \rightarrow \{\text{Carcieri}\} \\ \text{MA} \rightarrow \{\text{Romney}\} & \text{VT} \rightarrow \{\text{Douglas}\} \end{bmatrix} \end{bmatrix}$$

Given the $\langle s, et\rangle$ denotation repeated here,

(9) $[\![governor]\!]_{\langle s, et\rangle} =$
$[2002 \rightarrow \{\text{Rowland, King, Swift, Benson, Almond, Dean}\},$
$2005 \rightarrow \{\text{Rell, Baldacci, Romney, Lynch, Carcieri, Douglas}\}\ ]$

it might seem that *governor* needs to be lexically ambiguous between (the extensions of) these two denotations. But looking at the two functions, we can see that this is unnecessary. In particular, the information contained in the latter is a subset of the information contained in the former. We can derive the latter from the former by stripping out that information via existential closure (cf. Dowty's (xxxx) use of existential closure to intransitivize verbs such as *eat*):

(26) $\lambda P_{\langle s, \langle e, et\rangle\rangle} . \lambda w_1 . \lambda x_e . \exists y_e . [P(w_1)(y)(x) = 1]$

For *governor* in particular, the relational meaning and the common-noun meaning are:

(27) $[\![governor]\!]_{\langle s, \langle e, et\rangle\rangle} = \lambda w_1 . \lambda y_e . \lambda x_e . x$ is the governor of y at w_1
$[\![governor]\!]_{\langle s, et\rangle} = \lambda w_1 . \lambda x_e . \exists y_e . x$ is the governor of y at w_1

The latter is a derived meaning for *governor.* In §4.2.2.1 we saw that we cannot derive the set-of-ICs meaning for *governor* from this latter meaning, because the necessary governor-to-state associations were missing. However, we can derive it from the former. The relational meaning still indicates which state each governor-individual is the governor of, which needs to be built into the set-of-ICs meaning in order to ensure that the set contains the right ICs.

We saw in the previous section that there should not be any sort of intermediate $\langle e, \langle se, t\rangle\rangle$ denotation in the shifting process. Therefore, we want a type-shifting operation that takes the $\langle s, \langle e, et\rangle\rangle$ meaning and returns an object with type $\langle se, t\rangle$. This is not at all complex; we need only turn the external argument of the relational noun into an IC, and close off the complement.[8]

---

[8] Note that if we didn't include the existential closure as part of this process, we would have had the intermediary step in (i).

(i) $[\![governor]\!]_{\langle e, \langle se, t\rangle\rangle} = \lambda y_e . \lambda x_{se} . \forall w . [x(w)$ is the governor of y at $w] \equiv$

[CT → {[2002 → Rowland, 2005 → Rell]}, ME → {[2002 → King, 2005 → Baldacci]},
MA → {[2002 → Swift, 2005 → Romney]}, NH → {[2002 → Benson, 2005 → Lynch]},
RI → {[2002 → Almond, 2005 → Carcieri]}, VT → {[2002 → Dean, 2005 → Douglas]}]

(28) $\lambda P_{\langle s,\langle e,et\rangle\rangle} . \lambda x_{se} . \exists y_e . \forall w . [P(w)(y)(x(w)) = 1]$

Applying this to the intension of the relational noun *governor* given above, this produces a set of exactly those six ICs we wanted to quantify over:

(29) $[\![governor]\!]_{\langle se,t\rangle} = \lambda x_{se} . \exists y_e . \forall w . [x(w)$ is the governor of y at $w] \equiv$

{ [2002 → Rowland, 2005 → Rell], [2002 → King, 2005 → Baldacci],
[2002 → Swift, 2005 → Romney], [2002 → Benson, 2005 → Lynch],
[2002 → Almond, 2005 → Carcieri], [2002 → Dean, 2005 → Douglas] } (= 10a)

Now the IC *[2002 → Rowland, 2005 → Rell]* will be in the set $[\![governor]\!]_{\langle se,t\rangle}$, because there does exist an individual y such that, at each w, the value of the IC at w is a member of the set that the extension of $[\![governor]\!]_{\langle s,\langle e,et\rangle\rangle}$ at w assigns to y. (In this case, y = Connecticut; and the denotation of *governor* returns, at 2002, the set {Rowland} for the value Connecticut, which contains the value of the IC at 2002; and so forth.) The same is not true for ICs we wanted to exclude, such as *[2002 → Rowland, 2005 → Lynch]*. It is easy to see, as well, that this operation will produce ICs that permute the governors among their states only in exactly those situations in which the governors actually do swap states.

Summarizing, we have type-shifting operations and denotations for *governor* as follows.

(30) $\lambda P_{\langle s,\langle e,et\rangle\rangle} . \lambda w . \lambda x_e . \exists y_e . [P(w)(y)(x) = 1]$ $\langle s,\langle e,et\rangle\rangle \rightarrow \langle s,et\rangle$
$\lambda P_{\langle s,\langle e,et\rangle\rangle} . \lambda x_{se} . \exists y_e . \forall w . [P(w)(y)(x(w)) = 1]$ $\langle s,\langle e,et\rangle\rangle \rightarrow \langle se,t\rangle$

$[\![governor]\!]^w = \lambda y_e . \lambda x_e . [\text{governor}_w(y)(x) = 1]$ $\langle e,et\rangle$ (lexical)
$[\![governor]\!]^w = \lambda x_e . \exists y_e . [\![governor_{\langle e,et\rangle}]\!]^w(y)(x)$ $\langle e,t\rangle$
$[\![governor]\!]^w = \lambda x_{se} . \exists y_e . \forall w_1 . [\![governor_{\langle e,et\rangle}]\!]^{w_1}(y)(x(w_1))$ $\langle se,t\rangle$

The governor of Vermont uses $governor_{\langle e,et\rangle}$, which maps its argument to a set of individuals, from which *the* selects the unique individual; *every governor votes* uses $governor_{et}$. Interpreting *the governor of Vermont changed* uses $governor_{\langle e,et\rangle}$, along with Lasersohn's method of turning the individual into an individual concept. With $governor_{\langle se,t\rangle}$, we have a method of interpreting *every governor changed* without having had to introduce lexical denotations with type $\langle se,t\rangle$, which Lasersohn wished to avoid.

Before we move on, we should note that the $\langle se,t\rangle$ meaning is world-independent, having no free world variable. The world variable that's free in the $\langle e,et\rangle$ and $\langle e,t\rangle$ meanings of relational nouns, which allows them to be intensionalized, is necessarily bound by the universal operator that derives the set of individual concepts; "necessarily", because it is this universal binding of worlds that ensures that the individual concepts in the set are those which correspond to a consistent argument (e.g. the same state) across worlds. If the world argument were left unbound...

Though existential closure could then convert this to the meaning in (29), the infelicitous *Every governor of a New England state changed* could be interpreted using (i), exactly as described in (23). That was the meaning we wanted to prevent; (i) is exactly the meaning we do not want *governor* to be able to have.

(31) $*[\![governor_{\langle se,t\rangle}]\!]^w = \lambda x_{se} \,.\, \exists y_e \,.\, [\![governor_{\langle e,et\rangle}]\!]^w(y)(x(w))$
$= \lambda x_{se} \,.\, \exists y_e \,.\, [x(w) \text{ governs } y \text{ in } w]$

...then at any given index, $governor_{\langle se,t\rangle}$ would denote the set of individual concepts such that, for some y, the value of the individual concept *at that index* is a governor of y *at that index*. This is worse even than the meanings that derived from the $\langle s, et\rangle$ meaning of *governor*, as those at least required that the IC would map other indices to governors. In this case, any individual concept that maps 2005 to Mitt Romney will be in the extension of this set at 2005, as it would meet the requirement that it maps 2005 to the governor of some y at 2005. No restriction is set on what x maps other world/times to, and thus, in addition to *[2002 → Swift, 2005 → Romney]*, the set of ICs will contain *[2002 → Romney, 2005 → Romney]* and, for that matter, *[2002 → the planet Mars, 2005 → Romney]*. At 2002, of course, ICs that map 2002 to non-governors such as Romney and the planet Mars will not be in the set, though what the ICs map 2005 to is similarly unrestricted.

So the world variable must be bound; if it were bound existentially...

(32) $*[\![governor_{\langle se,t\rangle}]\!]^w = \lambda x_{se} \,.\, \exists y_e \,.\, \exists w_1 \,.\, [\![governor_1]\!]^{w_1}(y)(x(w_1))$

...then we would have a similar problem to the one above, with each IC in the set allowed to map worlds to practically anything, as long as it maps some world to the governor of something. (In fact, it is somewhat worse; the existential binding doesn't even guarantee that the value of x at any particular index is a governor at that index.) The universal binding ensures that each IC be consistent in its mappings.

This automatic world-independence solves Lasersohn's real objection to the use of sets of individual concepts. Recall from the last chapter that Lasersohn wanted to avoid a meaning postulate on *temperature* and *price*, repeated here,

(33) $\forall x_{se} \,.\, \Box\, [\alpha(x) \rightarrow \Box\alpha(x)]$

that would force lexical $\langle se, t\rangle$ denotations to be independent of indices. Such a postulate, he observes, is an "arbitrary lexical stipulation" (p. 130). The theory proposed in this section ensures that $\langle se, t\rangle$ denotations will necessarily be index-independent by means of the universal binding of the world variable in the type-shifting operation that derives the denotation. Therefore, the need for index-independent sets of ICs in Gupta's syllogism presents no problem for denotations like $governor_{\langle se,t\rangle}$, which are index-independent without requiring additional stipulation on the meanings themselves or on the $\langle e, et\rangle$ lexical meanings from which they derive.

4.2.3. Two kinds of relational noun

The analysis in the last section used *governor* to exemplify relational nouns, and in fact the same arguments and judgments hold with many other RNs, such as *capital* and *winner*. However, the shifting operations in (30) encounter problems when applied to, say, *price*.

(34) $[\![price]\!]^w = \lambda y_e \,.\, \lambda x_e \,.\, [y \text{ costs } x \text{ at } w]$ $\langle e, et\rangle$ (lexical)
$[\![price]\!]^w = \lambda x_e \,.\, \exists y_e \,.\, [y \text{ costs } x \text{ at } w]$ $\langle e, t\rangle$
$[\![price]\!]^w = \lambda x_{se} \,.\, \exists y_e \,.\, \forall w_1 \,.\, [y \text{ costs } x(w_1) \text{ at } w_1]$ $\langle se, t\rangle$

Using these shifters once again bypasses the $\langle e, \langle se, t\rangle\rangle$ denotation, correctly preventing an intensional interpretation of *every price of a....* All the same, it is not obvious that these are the meanings we want. Taking $price_{\langle e,t\rangle}$ in particular: while the set of governors in a world is the set of individuals who are governors of something in *that* world, the set of prices ought to be the set of individuals that are prices in *some* world. For instance, if \$1.99/gallon is a price at some world and time, it's a price even at a world and time when nothing has that as its price. On the other hand, Arnold Schwarzenegger is not a governor at indices when nothing has him as its governor. Thus, even in w_0, one can say of \$1.99/gallon that it is a price, even without knowing whether anything in w_0 has it as price—indeed, even if nothing has it as a price in w_0—on the basis of it being a possible price. One cannot in the same manner say in w_0 that, e.g., Noam Chomsky is a governor even though no state has him as a governor in w_0, on the basis of him being a possible governor (i.e. in some possible world he is the governor of Massachusetts).[9,10]

We can separate relational nouns into two classes, those like *governor* and those like *price*; nouns in both classes have lexical $\langle e, et\rangle$ denotations, but their $\langle e, t\rangle$ denotations differ as described above. Many nouns in the *price* class indicate measurements, such as *temperature, height, area,* and *age*. Just as $[\![$*\$1.99/gallon*$]\!]$ is a price at all indices, $[\![$*90 degrees Fahrenheit*$]\!]$ is necessarily a temperature, $[\![$*ten meters*$]\!]$ is necessarily a height, $[\![$*ten square meters*$]\!]$ is necessarily an area, and $[\![$*ten years (old)*$]\!]$ is necessarily an age. But not everything in this class is, strictly speaking, a measurement:

(35) a. *The color of Sam's hair* depends on whether she's still interviewing for jobs.
b. *The location of the meeting* depends on when we decide to hold it.
c. *The way to Harvard Square* depends on where you're coming from.

As with measurement nouns, individuals in the sets denoted by *color, location,* and *way* are in their respective sets across worlds. $[\![$*red*$]\!]$ is necessarily a color, points in space are necessarily locations, and paths are necessarily ways.[11] Again, *price*-class nouns differ from *governor*-class

[9] The same is true of times: one cannot say in 2005 that Howard Dean, governor of Vermont before Jim Douglas, is "a governor" (regardless of honorary title). In fact, he is a "former governor", and *former N* denotes the set of individuals who were in $[\![N]\!]^t$ for some $t < t_0$ and who are not in $[\![N]\!]^{t_0}$. But "\$1.99/gallon" is arguably a price even in prehistoric times, that is, before people paid in dollars (or, perhaps, at all), and "200 ducats a week" is still a price even though ducats have not been legal currency for years; the notion of a "former price" is hard to understand.

[10] It's not clear to me whether this argument extends to $price_{\langle se,t\rangle}$. An IC in the set denoted by $governor_{\langle se,t\rangle}$ must map each world to an individual who is a $\text{governor}_{\langle e,t\rangle}$ in that world, and the same will be true of *price*. However, *governor* is also constrained by each function having to pick out the governors of some given thing; does *price* have the same constraint, or is any mapping from worlds to prices a $\text{price}_{\langle se,t\rangle}$? I'm not prepared to rule out the latter, but neither am I certain how one could test this. I will provide mechanisms to derive this kind of $\langle se, t\rangle$ denotation, just in case; but at any rate the $price_{\langle e,t\rangle}$ facts in the text are secure enough that we can continue regardless of how the $\langle se, t\rangle$ facts fall out.

[11] Though with these latter two, the description may not apply in any given possible world. For instance, the description *the conference room on the fourth floor of the Stata Center at MIT* does not describe anything in w_0 at the time 1997, which is a time before the Stata Center was built at MIT, or in possible worlds in which the Stata Center is only three floors, or has no conference rooms on the fourth floor, etc. Nevertheless, the actual individual denoted by that description in w_0, which is a particular point in space, is a location in any world. Similarly, while at

nouns in this regard: Arnold Schwarzenegger is a governor in w_0 but is not necessarily a governor, nor is Rome necessarily a capital.

Let us call those relational nouns like *price*, whose range of values is index-independent, *abstract relational nouns* (ARNs), as the values of such nouns tend to be abstracts (numbers, colors, measures, and so forth). Those like *governor*, whose range of values at an index is dependent on that index, we will call *concrete relational nouns* (CRNs).

Based on the discussion in the preceding paragraphs, the shifting operations for CRNs such as *governor* seem not to apply to ARNs such as *price*.[12] We could instead derive ARN meanings some other way. For instance, we could use different shifters:

(36) $\lambda P_{\langle s, \langle e, et\rangle\rangle} . \lambda x_e . \exists y_e . \exists w_1 . [P(w_1)(y)(x) = 1]$ $\quad \langle s, \langle e, et\rangle\rangle \rightarrow \langle e, t\rangle$

$\lambda P_{\langle s, \langle e, et\rangle\rangle} . \lambda z_{se} . \forall w_2 . [\exists y_e . \exists w_1 . [P(w_1)(y)(z(w_2)) = 1]$ $\quad \langle s, \langle e, et\rangle\rangle \rightarrow \langle se, t\rangle$[13]

$[\![price]\!]^w = \lambda x_e . \exists y_e . \exists w_1 . [y \text{ costs } x \text{ at } w_1]$ $\quad \langle e, t\rangle$

$[\![price]\!]^w = \lambda x_{se} . \forall w_1 . [\![price_{et}]\!](x(w_1))$ $\quad \langle se, t\rangle$

The first shifter creates a set consisting of every individual such that it is the *P* of something in some possible world. (This does assume that everything in, for instance, $price_{et}$ is the price of some object in some possible world, and similarly for other nouns—everything that is a height is the height of something in some world, everything that is a color is the color of something in some world, and so on. Examining whether this is the case would take us deeper into philosophical questions than this dissertation has space for.)

But this theory is not sufficiently restrictive. In particular, the shifting operations in (36) will apply just as well to (the intension of) a CRN denotation as it does to an ARN denotation. Using these shifting operations creates a chicken-and-egg problem: ARNs and CRNs can be distinguished by the fact that the former but not the latter have the kind of meaning these type shifters produce, but restricting the type shifters to apply to ARNs but not CRNs requires being able to distinguish the two. We need an independent method to differentiate them, after which we can restrict the type shifters to be sensitive to this differentiation.

Let us start with ARNs that relate to measurements, such as *temperature*, *height*, and *price*. We have been assuming so far that, like CRNs, these denote $\langle e, et\rangle$ predicates; but if these predicates involve measures, we can refine this assumption by comparing them to adjectives that involve measures, i.e. scalar adjectives like *hot*, *tall*, and *expensive*.[14] Scalar adjectives are often treated as relating an individual and a degree on an ordered scale of values (Cresswell 1976, *inter alia*):[15]

---

different worlds or times a particular path might not get you to Harvard Square—the subway is broken at that time; Harvard Square was built elsewhere in that world; that world and time has a huge bottomless pit in the middle of that route—the path is still a "way".

[12] This may be too strong—$price_{et}$ may actually be used ambiguously between the set of all conceivable prices and the $governor_{et}$-like set of all actual prices, and similarly for $price_{\langle se, t\rangle}$. Even if this is the case, the following arguments still hold, as there must be a way to get the meanings described in the preceding paragraphs.

[13] If necessary. See footnote 10.

[14] Löbner (1981) offers a suggestion along these lines, in particular that *the temperature of x* denotes not a number such as *ninety* but "a certain value on a certain scale" (p. 474).

[15] See, e.g., Schwarzschild and Wilkinson (2002) for arguments that the interpretation of scalar adjectives requires not discrete points on scales but intervals on scales. Nothing said here should be incompatible with intervals.

(37) $[\![hot]\!] = \lambda d \,.\, \lambda x \,.\, x$ is hot to degree d
$[\![tall]\!] = \lambda d \,.\, \lambda x \,.\, x$ is tall to degree d
$[\![expensive]\!] = \lambda d \,.\, \lambda x \,.\, x$ is expensive to degree d

The degree d can be closed existentially (*Sandy is tall* means, roughly "there is a degree of tallness d such that things to that degree are 'tall', and Sandy is tall to that degree"), or bound by comparative or superlative morphemes, and so forth. Extending this analysis to relational nouns, we can take the "abstract" values of abstract relational nouns to be degrees, so that the nouns have the lexical type $\langle e, dt \rangle$.[16]

(38) $[\![temperature]\!] = \lambda x \,.\, \lambda d \,.\, x$ has degree d on the temperature scale
$[\![height]\!] = \lambda x \,.\, \lambda d \,.\, x$ has degree d on the height scale
$[\![price]\!] = \lambda x \,.\, \lambda d \,.\, x$ has degree d on the price scale

The internal argument is an individual; *price of milk* or *Sandy's height* denotes the set of degrees such that milk has that degree on the scale of prices, or that Sandy has that degree on the scale of heights. As with scalar adjectives, the sets of degrees are not singleton sets—if Sandy has the degree "six feet" on the height scale, she also has the degrees "five feet", "four feet", and so on for all degrees less than six feet. A definite determiner (or a possessive) will select the maximal degree from the set, hence the following contrast.

(39) a. We need someone six feet tall to reach that shelf. Fortunately, Sandy is six feet tall—in fact, she's six foot six—so we can get her to help.
b. #We need someone whose height is six feet to reach that shelf. Fortunately, Sandy's height is six feet—in fact, she's six foot six—so we can get her to help.

The second sentence in (39a) asserts that "six feet" is a degree of height possessed by Sandy, which is true if she's six and a half feet tall. The second sentence in (39b), however, asserts that "six feet" is the maximal degree of height possessed by Sandy, which is not true if she's six and a half feet tall.

By building scalar meanings into ARNs, the independence of their referents across worlds and times follows logically with minimal extra assumptions. We need only to take the laws of mathematics to be constant across worlds, which is a fairly tame assumption. The laws of mathematics ensure the existence of the scale of real numbers in every world; the linear scale of a scalar adjective or a scalar noun can be constructed by combining the scale of numbers with the appropriate unit of measurement, so these scales are also constant across worlds.[17] From these scales, we can derive the $\langle e, t \rangle$ and $\langle se, t \rangle$ meanings—or rather the $\langle d, t \rangle$ and $\langle sd, t \rangle$ meanings—directly and without reference to $\langle e, dt \rangle$ meanings at all, thereby obviating the need for the shifters in (36) or any others. For instance:

---

[16] I will use d in semantic types to indicate a degree argument. This move is primarily notational. I do not mean to commit myself to the notion that degrees are substantially different than individuals of type e, rather than being a special case, and I hope ontologists among my readers will refrain from sending angry letters.

[17] Which suggests that units of measurement—*dollar, ducat, meter, degree Fahrenheit*, and so forth—are rigid designators. This assumption is also, I hope, relatively uncontroversial.

(40) $[\![height_{\langle e,\, dt\rangle}]\!] = \lambda x\ .\ \lambda d\ .\ x$ has degree d on [a height scale]
$[\![height_{\langle d,\, t\rangle}]\!] = \lambda d\ .\ d$ is a member of [a height scale]
$[\![height_{\langle sd,\, t\rangle}]\!] = \lambda x_{sd}\ .\ \forall w\ .\ x(w)$ is a member of [a height scale]

...where "a height scale" is any scale derived by combining the real numbers with a measure of height, such as *feet*.[18]

What about ARNs which are not so obviously measurements, such as *color*, *location*, and *way*? Even though their denotations are not as obviously mappings to sets of numbers, each of these can be expressed as scales in some number of dimensions. Colors, for instance, can be expressed in two- or three-dimensional charts in various ways (colorwheels, etc.). We cannot, of course, say *the color of the sky is rising*, because *color* is not a one-dimensional scale like *temperature* or *price*, but we can talk about colors changing along dimensions with predicates like *fade*. Locations in space are similarly expressible as triples representing distance from an (arbitrary) origin; ways from one place to another can be expressed as a series of these triples.

We will return to the distinction between ARNs and CRNs in §5.3. The above discussion should suffice to show that the $\langle e, et\rangle$, $\langle e, t\rangle$, and $\langle se, t\rangle$ meanings of relational nouns relate to one another, though the details of the two kinds of relational noun may differ.

4.2.4. Deriving ICs from nonfunctional nouns

So far, this section has demonstrated how to derive sets of individual concepts from relational noun denotations. However, we began with data demonstrating not merely that relational nouns can denote sets of ICs, but that NPs in general can denote sets of ICs. In addition to *every governor changed* with its set of ICs based on the relational noun *governor*, we had:

(3b) (Each month,) every picture on Jordan's wall changes.

We still do not want NRNs like *picture* to lexically denote a set of ICs, but the shifting operations of the previous subsections cannot derive a set of ICs from its lexical denotation, as they apply to objects with $\langle e, et\rangle$ meanings. Because *picture* is not a relational noun, there is no variable to close existentially and thereby ensure that the correct set of ICs is derived.[19] So the previous techniques do not apply here.

4.2.4.1. Getting from sets of individuals to sets of ICs

By not having an argument that can be existentially closed, nonrelational nouns resemble the naive meaning for *governor* written in §4.2.2.1. That is, nothing will prevent the individual concepts in a set like *picture on Jordan's wall* from permuting the set, much the way the

[18] Alternately, we could limit the shifting operations in (36) to those relational nouns that make reference to scales, but the method in the text seems more elegant.

[19] Again, see footnote 3 for a discussion of why *picture* is not a relational noun. Additionally, note that the mechanism presented above to determine a set of ICs from the internal argument of RNs will not work for *picture* and its internal argument. If Jordan were a federal employee in 1975 with three different pictures of Nixon on her office walls, and she replaced each one with a different picture of Gerald Ford after Nixon's resignation, *Every picture on Jordan's wall changed* would be true. But we could not determine the ICs in *picture on Jordan's wall* in the same way as we did for RNs: the ICs do not select, at different indices, pictures of the same individual. Instead, each one selects a picture of Richard Nixon at the earlier index, and a picture of Gerald Ford at the later index.

incorrect denotation for *governor* permuted the governors between 2005 and 2007 in (11b). Suppose that Jordan has, on her wall, three paintings, A, B, and C. We require a way to prevent the set of individual concepts in (41) from being a possible denotation of *picture on Jordan's wall* in a situation where the pictures do *not* change,

(41) $\{[4/05 \rightarrow A, 5/05 \rightarrow B], [4/05 \rightarrow B, 5/05 \rightarrow C], [4/05 \rightarrow C, 5/05 \rightarrow A]\}$

lest it predict the truth of *Every picture on Jordan's wall changed in May* (because for every IC in the set, its value before May is different than its value in May).

For *governor* and other relational nouns, we used the additional argument to select the right ICs for the set. *Picture (on Jordan's wall)* lacks this kind of inherent argument. I would like to suggest that we can nevertheless introduce a pseudo-argument for *picture* through a type-shifting operation. We could allow this argument to turn the $\langle e, t\rangle$ meaning of *picture* into an $\langle e, et\rangle$ meaning. At this point, however, we should recall that the goal of this section is to derive intensional and extensional meanings for relational and nonrelational nouns, so that when we look for a procedure to turn RNs but not NRNs into CQs, the grammar can distinguish the two classes by type. Therefore, let us reserve the $\langle e, et\rangle$ type as a lexical type for RNs, underivable for NRNs. (This theoretical decision has additional empirical support: if an $\langle e, et\rangle$ meaning, or an $\langle e, \langle se, t\rangle\rangle$ meaning, were derivable for NRNs, we would expect the argument positions to be filled overtly with the same *of*-PP used to provide arguments to RNs; but they cannot be.)

We can avoid giving $\langle e, et\rangle$ denotations to NRNs by having the type-shifting operation introduce not merely an argument position but a *bound* argument position. As a post-lexical operation should not be able to alter the internal structure of the noun's meaning, the argument position itself can be simulated with a relation $R_{\langle s, \langle e, et\rangle\rangle}$ that expresses a correspondence between an object in the denotation of the noun and the pseudo-argument object:

(42) $\lambda P_{\langle s, et\rangle} . \lambda x_{se} . \exists y_e . \forall w . [P(w)(x(w)) \wedge R(w)(y)(x(w))]$ $\qquad \langle s, et\rangle \rightarrow \langle se, t\rangle$

$[\![p.o.J.w.]\!]^w = \lambda x_e . [\text{pic}_w(x) \wedge \text{on-J's-wall}_w(x)]$
$[\![p.o.J.w.]\!] = \lambda x_{se} . \exists y_e . \forall w . [[\text{pic}_w(x(w)) \wedge \text{on-J's-wall}_w(x(w))] \wedge R(w)(y)(x(w))]$

Given the intension of the set of individuals that are pictures on Jordan's wall, this shifting operation returns a set of ICs, the range of each of which comprises those objects which are pictures on Jordan's wall and which correspond to some y via a relation R. Compare this to the $\langle se, t\rangle$ meaning of *governor*, which is similarly the set of ICs whose ranges comprise those objects which are governors corresponding to some y, the only difference being that the correspondence between governors x and their ys is built into the RN *governor*.

Once this $\langle se, t\rangle$ denotation has been derived, the felicity of *every picture on Jordan's wall* follows from the usual composition principles. Of course, this operator still requires some explanation of the variable R: what relation between pictures and some other individuals produces the correct set of ICs? We will see that, with one caveat noted below, it does not matter what relation is chosen; it can be a salient relation, or an arbitrary relation that assigns a number to each individual in each set, or another relation entirely. For instance, suppose that in April, Jordan has pictures A, B, C on her north, south, and east walls respectively, and in May, she replaces A with X, B with Y, and C with Z. Then the following two $\langle s, \langle e, et\rangle\rangle$ relations produce the corresponding sets of ICs:

(43) a. $R_1 = \lambda w . \lambda x_e \in \{\text{north, south, east}\} . \lambda y_e . [y \text{ is a picture on Jordan's } x \text{ wall at } w]$
{[April → A, May → X], [April → B, May → Y], [April → C, May → Z]}

b. $$R_2 = \left[\text{April} \rightarrow \begin{bmatrix} 1 \rightarrow \text{A} \\ 2 \rightarrow \text{B} \\ 3 \rightarrow \text{C} \end{bmatrix}, \text{May} \rightarrow \begin{bmatrix} 1 \rightarrow \text{Y} \\ 2 \rightarrow \text{Z} \\ 3 \rightarrow \text{X} \end{bmatrix} \right]$$
{[April → A, May → Y], [April → B, May → Z], [April → C, May → X]}

The first, using a salient fact about the pictures, produces the set of individual concepts that map different indices to pictures on a particular wall. The second, using an arbitrary numbering system, produces the set of individual concepts that map different indices to pictures with the same arbitrarily chosen number. The two sets of ICs are different, but either way, *change* is true of each element of the set.

Advocating an arbitrary relation, thereby creating an arbitrary set of ICs, may seem to contradict the aforementioned conclusions of §4.2.2.1, where we saw that problems with permutations meant that picking the wrong set of ICs gave the wrong predictions for *Every/No governor changed*. When the governors were re-elected without switching states, the non-permuting set of ICs (11a) gave the correct truth conditions, while the permuting set in (11b) gave the wrong ones; when the governors switched states, the reverse was true.

(11) a. { [2005 → Rell, 2007 → Rell], [2005 → Baldacci, 2007 → Baldacci],
[2005 → Romney, 2007 → Romney], [2005 → Lynch, 2007 → Lynch],
[2005 → Carcieri, 2007 → Carcieri], [2005 → Douglas, 2007 → Douglas] }

b. { [2005 → Rell, 2007 → Baldacci], [2005 → Baldacci, 2007 → Rell],
[2005 → Romney, 2007 → Lynch], [2005 → Lynch, 2007 → Romney],
[2005 → Carcieri, 2007 → Douglas], [2005 → Douglas, 2007 → Carcieri] }

This led us to conclude that arbitrarily picking six "governor" ICs was not sufficient. We might think that an arbitrary set of "picture on Jordan's wall" ICs will have exactly the same problems, and that the $\langle se, t\rangle$ meaning should only derive from a salient relation, as in (43a).

What makes common-noun ICs different is that this sort of permutation is, in general, *not* allowed. Suppose Jordan moves around the three pictures on her wall at the beginning of May, so that she has the same three pictures in different places. In this situation, *every picture on Jordan's wall changed* is false, and *no picture on Jordan's wall changed* is true, which stands in direct opposition to the results of moving around the six New England governors. But if we use the relation R_1 from (43a) to derive the set of ICs, we get

(44) {[April → A, May → B], [April → B, May → C], [April → C, May → A]}

as the denotation of *picture on Jordan's wall*, and hence get the same results for the sentence as we did when we permuted the governors: it is the case that *change* is true of each IC in this set.

In fact, even making a particular ordering salient does not allow that ordering to serve as the *R* relation if it permutes the set, or rearranges it in any way such that the mapping changes entirely but the sets do not. Suppose two people are discussing a particular committee of the U.S.

Senate, which has been notable for how liberal its members are. The conversants observe that all five members of the committee, from the most liberal to the most conservative, always vote unanimously along the Democratic Party line. Then one points out,

(45) #On the first of May, every member of the committee changed. The most liberal member stepped down and was replaced with someone more conservative than anyone else on the committee.

The prominence of "most liberal to least liberal" in the context should make the following R available (where m_1 through m_5 are the members in April in order from most to least liberal, and m_6 is the new, least liberal member in May), thereby giving *member of the committee* the subsequent set of ICs.

(46) $R = \lambda w . \lambda x_e \in \{1, 2, 3, 4, 5\} . \lambda y_e$. [y is the xth most liberal committee member at w] =
[April $\rightarrow$ [1 $\rightarrow$ m_1, 2 $\rightarrow$ m_2, 3 $\rightarrow$ m_3, 4 $\rightarrow$ m_4, 5 $\rightarrow$ m_5],
May $\rightarrow$ [1 $\rightarrow$ m_2, 2 $\rightarrow$ m_3, 3 $\rightarrow$ m_4, 4 $\rightarrow$ m_5, 5 $\rightarrow$ m_6]]

$[\![$*member of the committee*$]\!]$ = { [April $\rightarrow$ m_1, May $\rightarrow$ m_2], [April $\rightarrow$ m_2, May $\rightarrow$ m_3], [April $\rightarrow$ m_3, May $\rightarrow$ m_4], [April $\rightarrow$ m_4, May $\rightarrow$ m_5], [April $\rightarrow$ m_5, May $\rightarrow$ m_6] }

Using this denotation, *every member of the committee changed* is true—*change* is true of each IC in the set. Nevertheless, the sentence is infelicitous.

All of this suggests that, as with relational nouns, the set of ICs denoted by a nonrelational noun cannot be just any arbitrary set; but unlike with relational nouns, the set of ICs is not restricted to match a particular semantically determined or pragmatically salient mapping. Hence the caveat mentioned above: it is not the case that R can be chosen arbitrarily from all possible relations. Instead, it must be a relation that, if a given x is in the set denoted by the nonrelational noun at two different times, maps the same y to each instance of x. That is:

(47) $\forall w_1, w_2 . \forall x_e . [[N(w_1)(x) \wedge N(w_2)(x)] \rightarrow \exists y_e . [R(w_1)(y)(x) \wedge R(w_2)(y)(x)]]$

where $N_{\langle s, et\rangle}$ is the set being shifted.[20]

---

[20] Properly speaking, R must have an additional restriction not mentioned above: at each index, each of the individuals in the set denoted by the common noun must be in some set in the range of R. This prevents selecting an R for $[\![$*picture on Jordan's wall*$]\!]_{\langle se, t\rangle}$ that, for instance, maps states to their governors, so that the expression denotes the empty set (as this R does not map anything to a set containing a picture on Jordan's wall, and thus there is no IC whose value at any time is both a picture on Jordan's wall and in a set in the range of R). In fact, recalling the intuition mentioned earlier in this chapter that the sentence *every picture on Jordan's wall changed* requires the two sets to be the same size, we can add to this restriction a requirement that, first, each x in the common-noun set is in only one set in the range of R, and second, each y in the domain of R maps onto a set containing only one of the elements of the common-noun set. Formally:

(i) $\forall w . \quad [\forall x_e \in N(w) . \exists y_e . [R(w)(y)(x) = 1 \wedge \forall z_e . [R(w)(z)(x) \leftrightarrow z = y]] \wedge$
$\forall y_e . \forall x_e, z_e \in N(w) . [R(w)(y)(x) = 1 \wedge R(w)(y)(z) = 1 \leftrightarrow z = x]]$

where, again, $N_{\langle s, et\rangle}$ is the set being shifted.

With this caveat, it no longer matters which R meeting these criteria is used. In the case where Jordan moves her pictures around without swapping in any new ones, the set of ICs will be based not on positions on her wall but on the necessity of each IC mapping to the same picture at each time—that is, the only relations meeting (47) are those of the form

(48) $[\text{April} \rightarrow [y_1 \rightarrow \text{A}, y_2 \rightarrow \text{B}, y_3 \rightarrow \text{C}],\ \text{May} \rightarrow [y_1 \rightarrow \text{A}, y_2 \rightarrow \text{B}, y_3 \rightarrow \text{C}]]$

for any arbitrary individuals y. In particular, the "which wall" R given above in (43a) will not be available. Conversely, when Jordan takes down her three pictures A, B, C and puts up new ones X, Y, Z, it does not matter whether R creates a set of ICs mapping each time to the picture in location y, or each time to the zth most beautiful picture at that time, or any other way of associating times with pictures—however the set is created, each IC in the set will have different values at different times.[21]

At last, we have a method of deriving $\langle se, t\rangle$ denotations for both RNs and NRNs, and doing so in such a way that we require only the lexical types $\langle e, t\rangle$ and $\langle e, et\rangle$. This gives us a theory of individual concept meanings that satisfies Lasersohn's criteria, while still differentiating between those nouns which form CQs naturally and those which do not.

4.2.4.2. Not getting from relational nouns to sets of individuals to sets of ICs

Before moving to the next section, in which we derive CQ meanings, we must consider the following unwelcome prediction: if the method just described can turn *any* $\langle s, et\rangle$ denotation into a set of ICs, it should be able to do so for the denotation of *governor of a New England state*. We know this DP has an extensional reading when quantified, so that *every governor of a New England state voted* involves quantification over the individuals in the set denoted by *governor of a New England state*, and thus the NP has an $\langle e, t\rangle$ denotation. In that case, we might expect that an arbitrary relation R can produce an $\langle se, t\rangle$ denotation:

(49) $[\![\textit{governor of} [\textit{a N.E. state}]]\!] = \lambda x_e\,.\,[\exists y_e\,.\,\text{new-england-state}(y) \wedge \text{governor-of}(y)(x)]$
$[\![[\textit{governor of} [\textit{a N.E. state}]]_{\langle se,\,t\rangle}]\!] =$
$\lambda x_{se}\,.\,\exists y_e\,.\,\forall w\,.\,[[\exists z_e\,.\,\text{NE-state}_w(z) \wedge \text{governor-of}_w(z)(x(w))] \wedge R(y)(x(w))]$

This latter formula is the set of ICs whose range is the individuals such that there is a New England state of which they are governor, and such that there is some y to which they each bear a certain relation. Suppose the relation R relates a person x to a state y if x is the governor of y. Then we can rewrite the above meaning as:

---

[21] One might be tempted to force the ICs to have as its later value the individual that replaced the individual at its earlier value. Thus, if Jordan replaced A with X, [April → A, May → X] would necessarily be an IC in *picture on Jordan's wall*. This would also explain the committee membership problem, but only in part: while [April → m_1, May → m_6] would have to be one of the ICs if m_6 replaced m_1, we would still need the restriction in (47) to prevent [April → m_2, May → m_3] out of the set, as m_2 and m_3 do not really "replace" themselves.

At any rate, using the "x_1 replaces x_2" method of determining R would not only allow but in fact require permutations in cases where the objects permute, as in the situation where Jordan replaces A with B, B with C, and C with A. This is exactly the case where we do not want a permutation.

(50) $\lambda x_{se} . \exists y_e . \forall w . [[\exists z_e . \text{NE-state}_w(z) \wedge \text{governor-of}_w(z)(x(w))] \wedge \text{governor-of}_w(y)(x(w))]$
(cf. [[*governor*]] from (30) : $\lambda x_{se} . \exists y_e . \forall w . \text{governor-of}_w(y)(x(w))$)

This makes *governor of a New England state* equivalent in meaning to the derived *governor* $\langle se, t\rangle$ with the added restriction that it contains only those ICs corresponding to New England states, and not those for all fifty states. However, this meaning is entirely incorrect, as we saw above:

(51) a. ?#Every governor of a New England state changed. (= 21a)
b. In New England, every governor changed. (≈ 22c)

If the shifting operation could apply to a derived $\langle e, t\rangle$ set such as the one derived from *governor of a New England state*, we'd expect (51a) to be felicitous and very possibly equivalent in meaning to (51b). The fact that it is not felicitous at all tells us that the $\langle s, et\rangle \rightarrow \langle se, t\rangle$ shifting operation, needed for quantification over ICs with NRN-headed NPs, cannot apply to NPs with RN heads.

I believe there are a few pragmatic restrictions that prevent *governor of a New England state* from being shifted to an $\langle se, t\rangle$ meaning. First, relational nouns may simply resist the addition of extra argument positions. Because the set denoted by *governor of a New England state* comprises individuals (i.e. people) who have already been related to some other individuals (i.e. states), there is an inherent pragmatic oddity to either relating each of them to another arbitrary individual or re-relating them to the same individual.

Second and more strongly, the particular non-permutation restriction on the shifting operator's R are incompatible with a relational noun. At a number of points, we have seen that relational nouns allow sets of ICs representing permutations, whereas R specifically disallows permutations. This is more than a casual incompatibility. The $\langle se, t\rangle$ denotations of relational nouns such as *governor* forced permutations by relating the individuals at different indices via the noun's other argument; R essentially requires an arbitrary relation, and indeed in the case of permuted governors would not even permit $governor_{\langle e, et\rangle}$ to relate the individuals who are governors at different times.

Therefore, the operation in (49) can be straightforwardly ruled out on pragmatic grounds, and the shifting operation that introduces to nonrelational nouns a kind of arbitrary second argument can be considered sufficient as the last piece in the explanation of individual concepts.

4.3. Deriving Concealed Question Meanings

At last, having established the possible $\langle e, t\rangle$, $\langle e, et\rangle$, and $\langle se, t\rangle$ denotations for nouns, we can decide what mechanisms we need to turn them into propositions—that is, concealed questions. We will start with relational nouns, and as nothing will rely on the distinction between ARNs and CRNs, we can use *price* as representative of all RNs (and we can once again treat the type-*d* argument as type-*e*). After that, we will look at NRNs.

4.3.1. Deriving CQs from relational nouns

In §4.2, we saw at least two ways to get IC meanings out of relational nouns—a single IC, which is to say an $\langle s, e\rangle$ object, results from intensionalizing the denotation of a definite description, and a set of ICs, which is to say an $\langle se, t\rangle$ object, derives from shifting the intensionalized denotation of a relational noun. Having done this, we could either use these ICs as CQs, following Romero (2005) and earlier authors, or derive propositions to use as CQs from them. But if we derive CQ meanings from $\langle s, e\rangle$ or $\langle se, t\rangle$ objects, we will produce CQ meanings for every definite DP, including those with NRNs like *the picture on Jordan's wall*—i.e., those which lack CQ uses.

Ultimately, what primarily distinguishes *the price (of milk)* from *the semanticist* is not that one or the other is an individual concept—as they can both be—but instead the fact that the former is compositionally built from a relational noun and the latter is not. Over the course of §4.2, DPs received denotations with various semantic types; but while the types $\langle s, e\rangle$ and $\langle se, t\rangle$ were available to DPs and NPs, respectively, headed by any noun, the type $\langle e, et\rangle$ remained reserved for relational nouns. To derive propositional meanings from relational nouns and only relational nouns, we can therefore rely on this latter type.

To capture the "identity question" paraphrase, we want an identity proposition. As a concrete starting point, let us take *John knows the price of milk* as a typical sentence with a CQ in it. As with previous theories, we need to both derive a CQ meaning for the DP and decide on a semantics for the verb. This latter task is simple. Because the CQ denotes a proposition, the predicate needs to take a propositional argument (followed, naturally, by an individual argument, which is the subject), and we already have a lexical entry for *know* with such a denotation: the declarative *know* used when the argument is a clausal proposition. In the following discussion, we will use Romero's $know_{\text{declarative}}$, and for our discussion we will need no other meaning for the verb.[22]

With the verb presenting no challenge, we need to derive a propositional meaning for the definite DP. Supposing that the (presuppositional) definite determiner performs its usual task of mapping a set to the unique member of that set (regardless of whether the members of the set are individuals or propositions), we can derive a propositional meaning from *the price of milk* by having *price of milk* denote a set of identity propositions—which is to say, the meaning of an identity question.

As noted above, though we could shift the set of individuals ⟦*price of milk*⟧, or its intension, into a set of propositions, the derivation would apply equally well to ⟦*semanticist*⟧ or ⟦*picture on Jordan's wall*⟧. Instead, we want to shift the function from individuals to sets of individuals, the $\langle e, et\rangle$ meaning, into a function from individuals to sets of propositions, an $\langle e, \langle st, t\rangle\rangle$ meaning. The operator in (52) fulfils this function.

---

[22] The next chapter includes a discussion of Lahiri (2000, 2002), who proposes interpreting clausal question complements of *know* and similar verbs as propositions, thereby eliminating $know_{\text{question}}$ from the lexicon. In fact, Lahiri's questions-as-propositions proposal provided much of the inspiration for the theory of concealed questions as propositions. This is especially true of §4.3.1.3, in which the discussion of Quantifier Raising (QR) relates closely to Lahiri's theory of Interrogative Raising (IR), which was itself inspired by QR.

A more complete discussion of IR is postponed until the next chapter primarily because, in spite of the inspiration IR provided for the theory that CQs are propositions, the truth of the latter does not depend on the truth of the former. In particular, Lahiri's theory may be correct, or we may still need $know_{\text{question}}$ to interpret question complements, but which one is true is tangential to the interpretation of CQs as propositions.

(52) $\lambda P_{\langle s, \langle e, et\rangle\rangle} . \lambda y_e . \lambda p_{st} . [\exists x_e . p = \lambda w_1 . P(w_1)(y)(x)]$ $\langle s, \langle e, et\rangle\rangle \rightarrow \langle e, \langle st, t\rangle\rangle$

This operator applies only to the intensions of relational noun meanings. *Semanticist* and *picture on Jordan's wall* have no relational noun denotation, so the mechanism that creates CQs out of RNs cannot apply to them.

When *price* shifts and takes *milk* as its first argument, it produces the set of propositions in (53), i.e. the denotation of ⟦*what a price of milk is*⟧. "A" price, and not "the" price, because nothing in the lexical denotation of *price*, nor in the above shifting operation, guarantees a unique price.

(53) $\lambda p_{st} . [\exists x_e . p = \lambda w_1 . x \text{ is a price of milk in } w_1]$

The definite determiner should now choose a unique proposition from the above set, and that proposition will be the denotation of *the price of milk*. This theory already faces a challenge: the set in (53) is not a singleton set. In fact, there are an infinite number of propositions of the form "x is a price of milk in w_1"; for any price x at all, the proposition that it's the price of milk will be in the set. How can the definite determiner select a unique proposition from a set of large, perhaps infinitely large, cardinality?

The answer is that all determiners set a pragmatic restriction on their arguments. It's a much-noted fact that *every student came to the party* does not mean that every student in the universe came to the party, only that every student in a contextually salient set came; similarly, *please hand me the key* is felicitous even when the universe contains more than a single key, as long as a single key is relevant to the discourse. There are many theories that explore how to incorporate the restriction, and where the division between the semantic and pragmatic contributions lies; for concreteness, I will assume the fairly simplified meanings in (54), in which C is a variable determined by context.

(54) $[\![the]\!]_{\langle et, e\rangle} = \lambda P_{et} . \iota x_e . [P(x) \wedge C_{et}(x)]$
$[\![the]\!]_{\langle\langle st, t\rangle, st\rangle} = \lambda P_{\langle st, t\rangle} . \iota p_{st} . [P(p) \wedge C_{\langle st, t\rangle}(p)]$

The variable C in the $\langle\langle st, t\rangle, st\rangle$ meaning for *the* limits the set to a single proposition which is, in some sense, contextually "relevant". But propositions are not necessarily salient in the context the way individuals are (and in fact the definite DP in *John knows the price of milk* is felicitous without context, unlike *John handed me the key*, which does require a context to determine a salient key). What C determines the unique proposition?

The same problem of selecting the correct propositions from a question denotation arises with the interpretation of clausal questions, a fact discussed by Lahiri (2002) and Beck and Sharvit (2002).

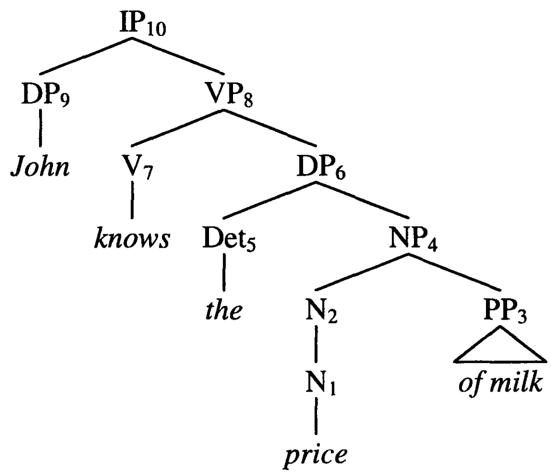
(55) a. Mary and John agree on who cheated. (≈ B&S, 114a)[23]
b. Mary is certain about who cheated. (≈ B&S, 117a)
c. Mary told us who cheated. (≈ B&S, 126a)

[23] Beck and Sharvit's actual sentences include the modifier *for the most part*, which we can set aside as irrelevant to the current discussion.

While *who cheated* in (55c) refers to the true answers to the question, the same question as the object of *agree on* or *be certain* refers not to the answers which are true in the actual world, but to those true in the subject's belief worlds (i.e. Mary's in (55b), Mary and John's in (55a)). The solution proposed by Lahiri, which Beck and Sharvit adopt into a somewhat different framework, is to incorporate into the meaning of the question a contextual variable whose value is determined by the verb, and which restricts the set of propositions to an appropriate subset. For a factive verb such as *tell*—the factivity of which, Lahiri observes, is not predictable from other facts about its meaning, and indeed, *tell* is not factive with propositions—the variable restricts the answers to the ones true in the world of evaluation; for the other verbs in (55), the variable restricts the answers to the ones true in the subject's belief-worlds.[24]

The variable Lahiri proposes works in exactly the same manner for our purposes here. In the next chapter, we will return to the particular theories of Lahiri and of Beck and Sharvit. But for now, we have all the pieces we need to see the compositional meaning of *John knows the price of milk.*

(56)



1	$\lambda y_e . \lambda x_e . [y \text{ costs } x \text{ at } w]$	$\langle e, et\rangle$	[[*price*]]
2	$\lambda y_e . \lambda p_{st} . \exists x_e . p = [\lambda w_1 . y \text{ costs } x \text{ at } w_1]$	$\langle e, \langle st, t\rangle\rangle$	shifter(^1)
3	milk	e	[[*milk*]]
4	$\lambda p_{st} . \exists x_e . p = [\lambda w_1 . \text{milk costs } x \text{ at } w_1]$	$\langle st, t\rangle$	2(3)
5	$\lambda P_{\langle st, t\rangle} . \iota p_{st} . [P(p) \wedge C(p)]$	$\langle\langle st, t\rangle, st\rangle$	[[*the*]]
6	$\iota p_{st} . [\exists x_e . p = [\lambda w_1 . \text{milk costs } x \text{ at } w_1] \wedge C(p)]$	$\langle s, t\rangle$	5(6)
7	$\lambda p_{st} . \lambda z_e . \forall w_2 \in \text{Dox}_z(w)\ [p(w_2) = 1]$	$\langle st, et\rangle$	[[*know*]]
8	$\lambda z_e . \forall w_2 \in \text{Dox}_z(w)\ [\ [\iota p_{st} .\ [\exists x_e . p = [\lambda w_1 . \text{milk costs } x \text{ at } w_1] \wedge C(p)]](w_2) = 1]$	$\langle e, t\rangle$	7(6)
9	john	e	[[*John*]]

[24] Properly speaking, the type of C in a concealed question is $\langle s, \langle st, t\rangle\rangle$: the proposition it selects varies by world, and the factivity variable is $\lambda w . \lambda p . p(w) = 1$, a function from a world to the set of propositions true in *that* world, not in the world of evaluation. In the extensional sentences discussed in this chapter, we can ignore the world variable; in the next chapter we will need to refer to it explicitly.

10 $\forall w_2 \in \mathrm{Dox}_{\mathrm{john}}(w)$ [t 8(9)

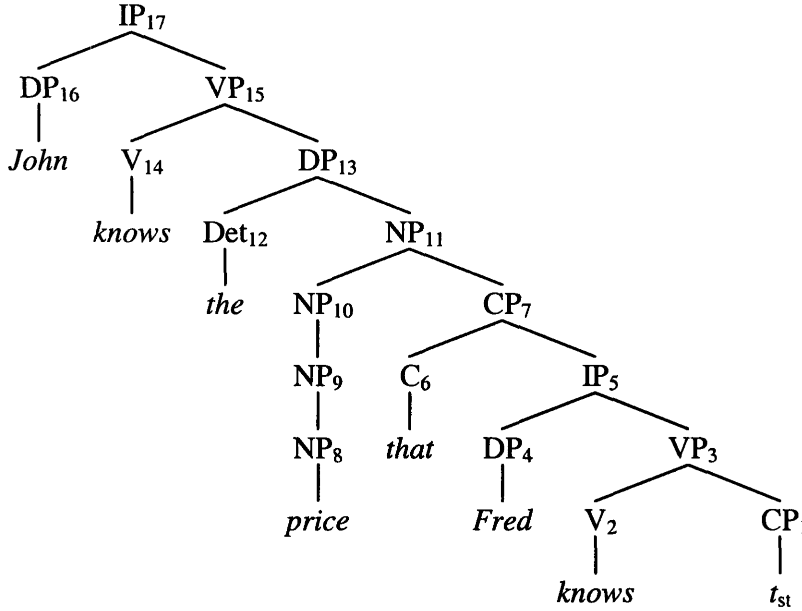
$$[\iota p_{st} .\ [\exists x_e . p = [\lambda w_1 . \text{milk costs } x \text{ at } w_1] \wedge C(p)]](w_2) = 1]$$

Step 6 has the denotation of the DP *the price of milk,* which is a proposition; in particular, it is the only proposition that, first, has the form [λw . milk costs x at w] for some x and, second, satisfies C. Since *know* is factive, C represents the propositions true in the world of evaluation; formally, $C = \lambda p . p(w_0)$. Consequently, the DP denotes the only true proposition in the world of evaluation that asserts that some x is the price of milk. If the price of milk in w_0 is \$1.99/gallon, then this proposition is *that the price of milk is \$1.99/gallon*, and the above sentence is true if in all worlds compatible with what John knows, the price of milk is \$1.99/gallon, and these are the correct truth conditions.

4.3.1.1. Heim's ambiguity, reading A

To be a serious candidate to replace Romero (2005), the theory that CQs are interpreted as propositions must also be able to derive both readings of *John knows the price that Fred knows.*

(57)



First, Reading A, paraphrasable as *John knows the same price that Fred knows.* (Note that the trace of *knows* has type $\langle s, t\rangle$ instead of type $\langle s, e\rangle$ as in Romero's derivation; once again we only need a single declarative *know* to interpret CQs.)

1	p_1	$\langle s, t\rangle$	$[\![t_{st}]\!]$
2	$\lambda p_{st} \,.\, \lambda z_e \,.\, \forall w_1 \in \text{Dox}_z(w)\ [p(w_1) = 1]$	$\langle st, et\rangle$	$[\![\textit{know}]\!]$
3	$\lambda z_e \,.\, \forall w_1 \in \text{Dox}_z(w)\ [p_1(w_1) = 1]$	$\langle e, t\rangle$	2(1)
4	fred	e	$[\![\textit{Fred}]\!]$
5	$\forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p_1(w_1) = 1]$	t	3(4)
6	lambda-abstraction introduction		
7	$\lambda p_{st} \,.\, \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p_1(w_1) = 1]$	$\langle st, t\rangle$	$\lambda p \,.\, 5$
8	$\lambda y_e \,.\, \lambda x_e \,.\, [y \text{ costs } x \text{ at } w]$	$\langle e, et\rangle$	$[\![\textit{price}]\!]$
9	$\lambda y_e \,.\, \lambda p_{st} \,.\, \exists x_e \,.\, p = [\lambda w_1 \,.\, y \text{ costs } x \text{ at } w_1]$	$\langle e, \langle st, t\rangle\rangle$	shifter(^8)
10	$\lambda p_{st} \,.\, \exists y_e \,.\, \exists x_e \,.\, p = [\lambda w_2 \,.\, y \text{ costs } x \text{ at } w_2]$	$\langle st, t\rangle$	∃-closure
11	$\lambda p_{st} \,.\, [\ \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p(w_1) = 1]\ \wedge$ $\exists y_e \,.\, \exists x_e \,.\, p = [\lambda w_2 \,.\, y \text{ costs } x \text{ at } w_2]]$	$\langle st, t\rangle$	$7 \wedge 10$
12	$\lambda P_{\langle st, t\rangle} \,.\, \iota p_{st} \,.\, [P(p)\ \wedge\ C(p)]$	$\langle\langle st, t\rangle, st\rangle$	$[\![\textit{the}]\!]$
13	$\iota p_{st} \,.\, [\ \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p(w_1) = 1]\ \wedge$ $\exists y_e \,.\, \exists x_e \,.\, p = [\lambda w_2 \,.\, y \text{ costs } x \text{ at } w_2]\ \wedge\ C(p)]$	$\langle s, t\rangle$	12(11)
14	$\lambda p_{st} \,.\, \lambda z_e \,.\, \forall w_3 \in \text{Dox}_z(w)\ [p(w_3) = 1]$	$\langle st, et\rangle$	$[\![\textit{know}]\!]$
15	$\lambda z_e \,.\, \forall w_3 \in \text{Dox}_z(w) \,.\, [$ $\iota p_{st} \,.\, [\ \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p(w_1) = 1]\ \wedge$ $\exists y_e \,.\, \exists x_e \,.\, p = [\lambda w_2 \,.\, y \text{ costs } x \text{ at } w_2]\ \wedge$ $C(p)](w_3){=}1]$	$\langle e, t\rangle$	14(13)
16	john	e	$[\![\textit{John}]\!]$
17	$\forall w_3 \in \text{Dox}_{\text{john}}(w) \,.\, [$ $\iota p_{st} \,.\, [\ \forall w_1 \in \text{Dox}_{\text{fred}}(w)\ [p(w_1) = 1]\ \wedge$ $\exists y_e \,.\, \exists x_e \,.\, p = [\lambda w_2 \,.\, y \text{ costs } x \text{ at } w_2]\ \wedge$ $C(p)](w_3){=}1]$	t	15(16)

Note that the lexical, relational meaning of *price* shifts in meaning twice, first into a "relational proposition" via the shifter in (52) which was also used in the derivation in (56), and second into a set of propositions via the same existential closure that turned relational *price* into a set of individuals and relational-IC *price* into a set of ICs. In this case, with the y variable bound existentially, *price* is the set of propositions which, speaking informally, express that something is the price of something else.

The above formula asserts that some proposition p is true in all of John's knowledge worlds; in particular, it's the unique proposition that (i) is true in all of Fred's knowledge worlds, and (ii) expresses that x is the price of y (for some x, y) as well as being true (i.e. satisfying the restriction C). Once again, these are the correct truth conditions.

Comparing this to Romero's derivation for the same sentence, it's apparent that the two follow the same fundamental principles. In each case, there's some "price" object which has a certain value in all of Fred's knowledge worlds and the same value in all of John's knowledge worlds. For Romero, that object is an individual concept and its value is the individual which corresponds to the object's price in the actual world. For the CQ-as-proposition theory proposed here, that object is a proposition and its value is "1" or "true". Insofar as the two derivations are parallel, it's unsurprising that they capture Reading A equally well.

4.3.1.2. Heim's ambiguity, reading B

To derive Reading B, consider what distinguishes it from Reading A. Because interpreting CQs uses a single, proposition-embedding meaning for *know*, Reading B does not require an intensionalized object (and the rising meanings Heim describes do not require infinite intensionalization). Taking seriously the idea that Reading B asserts that John knows the answer to a meta-question, we can think of the two propositions as follows.

(58) Reading A: John knows that the price of milk is [the actual price of milk].
Reading B: John knows *that Fred knows that* the price of milk is [the actual price of milk].

Of course, as John needn't know the actual price of milk for Reading B to be true, the embedded proposition cannot be spelled out in paraphrase in quite the same way. In reading A, we can substitute "$1.99/gallon", or whatever the actual price of milk is, for the bracketed phrase, but we don't want that to be part of John's knowledge in Reading B. It could be paraphrased with a free relative, e.g. "whatever the price of milk actually is"; or the proposition that John knows could be phrased "that Fred knows that q, where q is the appropriate 'the price of milk is ___' proposition". In any case, the meta-answer is created in the paraphrase by wrapping another proposition around the one from Reading A.

The compositional semantics can realize the above intuition by means of another shifting operation, not one that changes the function denoted by relational-noun *price* into a different proposition than the shifter in (52), but one that changes the set of propositions derived by that operation into a new set of propositions that has an extra propositional layer added to it. In particular:

(59) $\lambda P_{\langle s, \langle st, t\rangle\rangle} . \lambda p_{st} . [\exists q_{st} . p = \lambda w_1 . P(w_1)(q)]$

This takes the intension of a set of propositions and returns a new set of propositions p, each of which represents the set of worlds in which some proposition q is in the original set.

Let's see it in action by applying it to the intension of the set of propositions derived above as the meaning of *price that Fred knows* in step 9 of Reading A.

(60) $[\lambda P_{\langle s, \langle st, t\rangle\rangle} . \lambda p_{st} . [\exists q_{st} . p = \lambda w_4 . P(w_4)(q)]]$
$(\lambda w_3 . \lambda r_{st} . [\forall w_1 \in \text{Dox}_{\text{fred}}(w_3)[r(w_1) = 1] \wedge \exists y_e . \exists x_e . r = [\lambda w_2 . y \text{ costs } x \text{ at } w_2]]) \equiv$

$\lambda p_{st} . [\exists q_{st} . p = \lambda w_4 .$
$[\forall w_1 \in \text{Dox}_{\text{fred}}(w_4)\ [q(w_1) = 1] \wedge \exists y_e . \exists x_e . q = [\lambda w_2 . y \text{ costs } x \text{ at } w_2]\ ]]$

This is the set of propositions p such that there is a q which asserts, for some x and y, that x is the price of y, and which is true in every world compatible with what Fred knows in the world of evaluation of p. Taking the unique true proposition (after contextual restriction) from this set via the definite determiner and making the DP the object of *John knows...*, we have the following logical form for Reading B of the sentence *John knows the price Fred knows*.

(61) $\forall w_3 \in \text{Dox}_{\text{john}}(w) . [\ \iota p_{st} . [C(p) \wedge \exists q_{st} . p = \lambda w_4 .$
$[\forall w_1 \in \text{Dox}_{\text{fred}}(w_4)\ [q(w_1) = 1] \wedge \exists y_e . \exists x_e . q = [\lambda w_2 . y \text{ costs } x \text{ at } w_2]]](w_3)=1]$

This asserts that the proposition John knows is the (true) one that expresses that Fred knows some (particular) price, which is the right meta-knowledge for John to have.

For Heim's meta-meta-knowledge sentence and any higher sentences, iterating this shifting operation will continue to produce the right (singleton) sets of propositions. Thus, repeating Heim's example,

(62) John knows the price known to Fred that Bill knows. (Heim 1979, (36))

The different readings described in the previous chapter can be derived by shifting different sets of propositions. That is, to get Reading W (on which John, Fred, and Bill all know what the price of x is, for some x), neither *price known to Fred* nor *price known to Fred that Bill knows* is shifted; to get Reading Z, on which Fred knows the price of x, Bill knows that Fred knows the price of x, and John knows that Bill knows that Fred knows the price of x, both sets of propositions are shifted. Shifting one or the other but not both gives the intermediate X and Y readings.

4.3.1.3. Quantifiers other than the

Heim (1979) discusses inferences of the following sort, in which the latter sentence should logically follow from the former.

(63) a. John knows every price.
$\vdash$John knows the price of milk. (cf. Heim 1979, 22)

b. John knows every price.
$\vdash$John knows a price. (cf. Heim 1979, 32)

She demonstrates that both the CQs-as-ICs theory and the pragmatic theory she proposes capture the validity of this inference. What about the new theory proposed above?

Using the same $\langle st, t\rangle$ denotation of *price* to interpret *every price* and *a price* as we used for *price that Bill knows*, the quantifiers quantify over the following set of propositions:

(64) $\lambda p_{st} . \exists y_e . \exists x_e . p = [\lambda w_2 . y \text{ costs } x \text{ at } w_2]$

The quantifier in each case has the type $\langle\langle st, t\rangle, \langle\langle st, t\rangle, t\rangle\rangle$,[25] and the quantified DP raises from object position as it does in ordinary Quantifier Raising (QR). The sentences in (63b) have the following logical forms.

---

[25] Perhaps more transparently, this type is $\langle Pt, \langle Pt, t\rangle\rangle$, where P is the proposition type $\langle s, t\rangle$; in this respect, this denotation of *a* or *every* is a crosscategorial variant of the more familiar $\langle et, \langle et, t\rangle\rangle$ denotation. Just as type $\langle et, \langle et, t\rangle\rangle$ determiners relate two sets of individuals, these determiners relate two sets of propositions.

(65) $\forall p_{st} . [\exists y_e . [\exists x_e . p = [\lambda w_2 . y \text{ costs } x \text{ at } w_2] \wedge C(p)]] \rightarrow [\forall w_1 \in Dox_{john}(w) [p_1(w_1)=1]]$
$\vdash \exists p_{st} . [\exists y_e . [\exists x_e . p = [\lambda w_2 . y \text{ costs } x \text{ at } w_2] \wedge C(p)]] \wedge [\forall w_1 \in Dox_{john}(w) [p_1(w_1)=1]]$

The latter follows from the former just as *John likes every teacher* entails *John likes a teacher.* The same reasoning holds for the inference *John knows the price of milk.* Of course, determiners other than *every* and *a* show the same quantification, and the quantification over propositions works as well with other verbs: *John told me no European capital*, *John predicted most Academy Award winners for 2005*, and so forth.

Allowing quantification over a set of propositions opens a few more possibilities that must be explored. First, if instead of quantifying over the argument via existential closure, a sentence provides an explicit argument for the relational noun, a quantifier should still be acceptable. The data bear out this prediction, though of course not all such quantification is pragmatically felicitous—*every governor of Vermont*, in a world where each state has only one governor, is no better a set of propositions than it is a set of individuals. But where an individual might have more than one value associated with it, as with colors, a quantifier is fine.

(66) John knows every color of the rainbow.
$\forall p_{st} . [\exists x_e . p = [\lambda w_2 . x \text{ is a color of the rainbow at } w_2] \wedge C(p)] \rightarrow$
$[\forall w_1 \in Dox_{john}(w) [p_1(w_1)=1]]$

In other words, for every (true) proposition that expresses that x is a color of the rainbow, John knows the proposition to be true—once again, the correct truth conditions.

In §4.2.2, we prevented *every governor of a New England state* from denoting a set of individual concepts by shifting *governor* directly into a set of ICs, without first making it a function from individuals to sets of ICs. Without an argument to fill, the set-of-ICs denotation of *governor* cannot compose with *of a New England state.* But the shifting operation in (52) explicitly leaves the argument position open. Therefore, we would expect that the object of the relational noun need not be a type-*e*-denoting object like *the rainbow* in (66), but that it can be a quantificational DP such as *a New England state* and that, moreover, the DP can have the narrow scope that is disallowed for the set-of-ICs meaning. In fact, this is the case:

(67) Kim knows every governor of a New England state.

This sentence is felicitous with the predicted meaning, namely "for every (true) proposition p such that there is a New England state y for which p asserts that some x is a governor of y, Kim knows p". And as above, this holds true for other predicates and other quantifiers: *Kim told us three governors of a New England state*, for example. The acceptability of these DPs as CQs is all the more striking in light of their unacceptability as ICs.

4.3.2. Deriving CQs from nonrelational nouns

So far, this section has discussed relational nouns, which form CQs without the need for additional syntactic material. In §4.1, we distinguished these from nonrelational nouns, those such as *city*, *semanticist*, *wine*, or *person*, for the very reason that DPs headed by nouns of this latter class do not readily act as CQs. Thus, even with a context establishing the uniqueness of the referent, *the city...* is infelicitous as a CQ whereas *the capital...* is fine.

(68) a. Let me tell you the capital of Vermont.
b. Vermont has only one large city. #Let me tell you {the city/the large city/the large city of Vermont/Vermont's large city}.

If we want to derive propositional meanings for those, and only those, DPs with NRNs that can be CQs, we will need to understand which DPs these are.

4.3.2.1. Methods of CQ formation from nonrelational nouns

As a starting point, many DPs that could not otherwise be a CQ can be used as one if the context can force a relational interpretation—that is, if the NRN heading the DP can be reinterpreted as an RN. For example, take the following context, based on a suggestion from Lynsey Wolter (p.c.): suppose that the University of Southern North Dakota, Hoople, announces that they are eliminating their science departments in order to put more funding into linguistics. Instead of separate departments of chemistry, physics, biology, geology, and so forth, they plan to establish a single Department of Science, with one faculty member representing each field. In this context, one might say (69):

(69) Kim told me Hoople's biologist.

In general, *biologist* is not a relational noun, but in this context it does act as a function from one individual to another, specifically the function from a category of scientist x to the (singleton set containing the) x at Hoople. The context in which every institute of higher learning (by mutual agreement, or governmental policy, or the like) reduces its biology department to a single faculty member also makes (69) felicitous; in this case *biologist* is a function from a school y to the (singleton set containing the) biologist at y.

This pragmatic method works in sufficiently rich context. If said out of the blue, however, the acceptable-in-context (69) becomes odd; similarly, the sentences in (70) may be felicitous in contexts that allow *semanticist* or *city* to have relational noun interpretations, but they are otherwise ungrammatical. On the other hand, the sentences in (71), with the same NRNs, need no context.

(70) a. #Tell me USNDH's semanticist.
b. #Tell me Vermont's large city.
c. #Tell me a city in Vermont.

(71) a. Tell me the semanticist who teaches at USNDH.
b. Tell me {the largest city in Vermont/Vermont's largest city}.
c. Tell me a city you visited last month.

In fact, the DPs in the latter set cannot easily be reinterpreted as functions: for instance, *city you visited last month* does not suggest that *city* represents some salient and general mapping from people to the set of cities they visited last month, or from months to the set of cities you visited during that month, or any other such function.[26]

In general, then, we want a semantic explanation and not a pragmatic one. The $\langle st, t\rangle$ meaning will need to derive from some contribution of the denotation of the modification (or of the structure itself), a contribution absent from those modifications which do not turn DPs into CQs. So let us consider which modifications these are. (71) shows that relative clauses and superlatives create CQs; (70) shows that prepositional phrases and possessives do not.

Adjectives without superlative morphology, such as *large* in (70b), also seem not to produce CQ meanings. In fact, the data with adjectives is somewhat complicated by a difference, discovered by Bolinger (1967), between prenominal and postnominal adjectives. The following scenario illustrates a striking example of the contrast.

(72) Kim and Sandy are working on a project together, under the direction of Sam. Kim is a fine, upstanding person who never forgets deadlines and is wholly reliable. Sandy is much more absent-minded and is prone to carelessness. While walking together to their office, Sandy tripped and spilled a box of papers, which got wet, torn, and generally mutilated. Gathering up the papers, they continued to the office and left the papers on a table, where Sam saw them. At that point...
a. Sam yelled at the responsible person.
b. Sam yelled at the person responsible.

The sentence in (72a) asserts that Sam yelled at Kim, who is the *responsible person*; prenominally, *responsible* can only mean "reliable".[27] On the other hand, the sentence in (72b) asserts that Sam yelled at Sandy, who is the *person responsible*; postnominally, *responsible* can only mean "to blame for".

The sentences in (72) are part of a more general paradigm, in which an adjective used prenominally expresses, informally speaking, a permanent property, and used postnominally expresses a temporary property. Thus, being responsible is a long-term fact about Kim, whereas being responsible is true of Sandy only in this particular situation. This distinction becomes even more apparent when one compares pre- and post-nominal uses of the same sense of a single adjective. Thus, the determiner phrase in (73a) refers to the rivers that one can, generally speaking, navigate (and when it is the subject of *include the Volga*, the proposition asserts that the Volga is such a river); the determiner phrase in (73b) denotes those rivers that can be navigated *at the moment*—those that, in addition to being generally navigable are not currently flooded, frozen over, etc.

(73) a. the navigable rivers (include the Volga)
b. the rivers navigable (include the Volga)

[26] These mappings could conceivably derive from focus placed on the appropriate lexical item—*city [you]$_F$ visited last month* might be a mapping from individuals to the cities they visited last month—but the CQ interpretations of these DPs do not require any such focus.

[27] To some degree, (72a) has a reading on which *the responsible person* refers to Sandy. The availability of this reading will be explained in footnote 28 on page 117.

Further evidence for this distinction comes from the acceptability of (74a), with a stage-level adjective after the noun, and the unacceptability of (74b), with an individual-level adjective after the noun.[28]

(74) a. the children sick
b. #the children tall

For our purposes, the distinction between pre- and postnominal modification is relevant because, while prenominal adjectives do not turn NRNs into CQs, postnominal adjectives can.

(75) a. #Sam wanted to know the responsible person.
b. Sam wanted to know the person responsible.

Following the scenario above, (75a) cannot be used to mean "Sam wanted to know who the responsible person was (and it was Kim)", though this meaning would fit the situation (if for instance Sam wanted to know who could be trusted to repair the damage done). However, (75b) does mean that "Sam wanted to know who the person responsible was (and it was Sandy)". So postnominal modification with an adjective is one way to turn a non-relational noun into a CQ.

Given these distinct methods of forming a CQ from an NRN (postnominal adjectives, relative clauses, superlatives), none of which rely on the pragmatics discussed at the start of this subsection, we need to find a way to derive propositional meanings from the denotations and compositional principles. For instance, we could shift the entire NP if we could find a distinction—one not opaque at the NP level—between a bare noun like *city*, which cannot be shifted, and a modified noun like *city you visited last month*, which can. Or we could try to find a way to shift the denotation of the noun itself to something that yields a proposition, if the shift were only completed by appropriate modification.

4.3.2.2. The semantic ramifications

Instead, I believe that the simplest solution is to have the modifier itself perform the shift. That is, while modifiers—adjectives and relative clauses—usually denote a set of individuals and

[28] We also have the judgments in (i). The former DP denotes the subset of "navigable rivers" (rivers that are generally navigable) that cannot currently be navigated. The latter DP denotes the subset of "unnavigable rivers" (those that cannot be navigated) that one can currently navigate: the empty set, as no unnavigable rivers will ever be temporarily navigable.

(i) a. the navigable rivers unnavigable
b. #the unnavigable rivers navigable

Larson (1999) further observes that when adjectives describing temporary states can come before the noun, they precede those describing permanent states.

(ii) a. the unnavigable navigable rivers
b. #the navigable unnavigable rivers

For this reason, *the responsible person* has, to some extent, a reading on which *responsible* has a temporary meaning, i.e. on which it is synonymous with the only reading of *the person responsible*. The availability of that reading depends on *responsible* going into the earlier adjective slot, and the slot closer to the noun remaining empty. For the sake of explication, I will use prenominal adjectives only on their "permanent" readings.

compose with the noun via predicate modification, there is an operator that turns a modifier into a shifting operation, taking the $\langle e, t\rangle$ denotation of a noun as its argument and returning a set of propositions. For instance, if the relative clause *that Kim visited last month* has the simplified denotation in (76a), it also has the denotation in (76b)...

(76) a. λx_e . Kim visited x last month
b. $\lambda P_{\langle s, et\rangle} . \lambda p_{st} . [[\exists x_e . p = \lambda w_1 . [P(w_1)(x) \wedge \text{Kim visited } x \text{ last month in } w_1]]$

...so that *city Kim visited last month* denotes the set of propositions which, for some x, express that x is a city and that Kim visited x last month, which is exactly the meaning we want. Therefore, we have the following shifting operation, which wraps a propositional meaning around "$P(x) \wedge Q(x)$", roughly the result of predicate modification.

(77) $\lambda Q_{\langle s, et\rangle} . \lambda P_{\langle s, et\rangle} . \lambda p_{st} . [[\exists x_e . p = \lambda w_1 . [P(w_1)(x) \wedge Q(w_1)(x)]] \qquad \langle e, t\rangle \rightarrow \langle et, \langle st, t\rangle\rangle$

Using this shifter, we can derive propositional meanings for DPs like *the city you visited last month* or *the biologist who teaches at USNDH* without assigning any meaning other than the lexical $\langle e, t\rangle$ meaning to the NRNs at their heads.

Portner and Zanuttini (2005) independently reach a similar conclusion about nominal exclamatives such as *The strange things he says!*, which they argue to be syntactically DPs with clause-like semantics, whether used as matrix or embedded exclamatives. They interpret these exclamatives with a morpheme very much like the one in (77)—in fact, barring notational variation, the formula in their (34a) differs from the one independently derived here only by the inclusion of factivity (a sensible inclusion, as all exclamatives are factive).[29]

Portner and Zanuttini assign this shifting operation as the meaning of the *wh*-word, rather than including it as a separate element in the derivation; I hesitate to do so. Certainly, placing the shifting operation into the relative clause morphology would explain why a relative clause (like *you visited last month*) can shift an NRN into a set of propositions, while a prepositional phrase (like *in Vermont* cannot). However, other forms of nominal modification also license this shift, even without relative clause morphology: for instance, the superlative in (71b), *Tell me Vermont's largest city*, turns the otherwise non-CQ *Vermont's large city* into a CQ.

For CQs, we could adopt the analysis that the shifting operation above is part of the relative clause morphology, and find other methods of deriving CQ meanings for other forms of modification. It's plausible, for example, that superlative morphology genuinely does add an extra argument, so that an NP like *largest city* has an $\langle e, et\rangle$ denotation that maps places to the singleton sets containing their largest cities, and this $\langle e, et\rangle$ argument can undergo the same shifting operations as those that have the type lexically. On the other hand, we will see evidence in the next chapter that suggests the need to reserve some semantic type to only relational nouns, which suggests that $\langle e, et\rangle$ denotations for superlatives may not be correct.

---

[29] In general, their discussion of CEs, when compared to the discussion here of CQs, underscores how similar the two are. For instance, they use the term "nominal exclamatives" to distinguish the exclamatives they discuss, which can be used as matrix exclamations, from the "concealed exclamatives" discussed by Grimshaw, such as the one in *John couldn't believe the height of the building*, which cannot. I suspect that CEs which can be used only in embedded contexts are exactly those with RNs like *height*, as opposed to NRNs like *thing*, though exploring this suspicion will once again take us beyond the scope of this dissertation.

To find a unified semantic categorization of which nominal modification can create a CQ, I think the most promising starting point is offered by the distinction between prenominal and postnominal adjectives, namely that the former denote permanent (i.e. stage-level) properties while the latter denote temporary (i.e. individual-level) properties. Judgments vary somewhat on whether a DP with a relative clause providing an individual-level property (e.g. *the person who's (always so) responsible*) can be used as a CQ. If it cannot, using the stage/individual-level distinction seems even more likely to be correct, and there is enough uncertainty about such examples to warrant further consideration. On the other hand, a relative clause like *that Kim visited in June 2005* (i.e. the familiar *that you visited last month*, but with the indexicality removed) is fairly static, not something that changes over time, and thus seems less likely to provide an individual-level property.

A related approach involves events. If, as Larson (1999 *inter alia*) suggests, a postnominal adjective makes reference to an event, the same might be true of certain relative clauses. Thus, *that Kim visited* contains a reference to an event of visiting, and *who is responsible for this* refers to a specific event at which someone has the "responsible" property, whereas *who is always so responsible* refers to no single event, or has a generic operator binding the event (so that it means something like "in most events/situations e, x is responsible in e"). This latter possibility, however, seems incompatible with a sentence like

(78) I can't remember the city John visits when he's in Europe.

which seems fine with a CQ meaning (*I can't remember which city John visits...*), even though the relative clause exhibits the classic case of a generically bound event ("Generally, in events e which are events in which John visits Europe, John visits city x").

Neither of these approaches applies to superlatives (or the related modifier *favorite*) in an obvious way. In general, one thinks of a superlative as a fairly stable property of something; but at the same time superlatives exhibit context-dependence, so it's not unreasonable to think of, e.g., *the tallest mountain* as denoting different mountains at different times/events/etc. *Favorite* does not vary so easily; though John might change his mind, *John's favorite x* doesn't typically vary across events. (It might vary, of course: *John's favorite musical artist depends on his mood* is a perfectly sensible description of John if he always listens to Pink Floyd when depressed and Britney Spears when cheerful. But it needn't.)

Essentially, a complete understanding of which modifiers can become functions that turn sets of individuals into sets of propositions must await a more thorough analysis of the semantics of these modifiers. Whatever attribute of a modifier turns out to license this change, however, we can at least take the shifting operation in (77) as providing us with a method of building concealed questions from nonrelational nouns.

4.4. Summary

This chapter has provided a complete set of mechanisms for deriving individual concept meanings and concealed question meanings for the range of DPs that exhibit them, while blocking overgeneration of such meanings for DPs that do not exhibit them. While IC meanings remain common in the grammar, they are uniformly derived meanings; CQ meanings, which are less ubiquitous, are also derived. Lexically, only $\langle e, t\rangle$ meanings (for nonrelational nouns) and $\langle e, et\rangle$ meanings (for relational nouns) are required.

In Chapter 2, we rejected question meanings for CQs primarily because the distribution of CQs can be characterized semantically in a way that question meanings failed to capture. Therefore, our next step will be to return to that semantic characterization, to see how the theory presented in this chapter can provide an explanation for it.

CHAPTER 5 – THE PCQC

We ended Chapter 2 with the Proposition/Concealed Question correlation, based on the general correlation seen in (2).

(1) **The Proposition/Concealed Question Correlation (PCQC)**
In Case-assigning argument positions that allow questions, propositions and concealed questions have the same distribution.

(2) Comparison of CQ embedding and proposition embedding

	a. *know*	b. *learn*	c. *tell*	d. *decide*	e. *predict*	f. *be certain*	g. *wonder*	g′. ***ask***	h. ***care***
CQ	✓	✓	✓	✓	✓	✓	*	✓	*
Prop.	✓	✓	✓	✓	✓	✓	*	*	✓

We also observed that assigning question denotations to CQs necessarily leaves this correlation unexplained.

However, with the theory that CQs have propositional denotations, this correlation almost follows as an immediate logical consequence. The immediate prediction of the theory would be stronger: looking only at the compositional semantics, we would expect propositions and concealed questions to have the same distribution, without qualification. This chapter takes up both the qualification that the PCQC applies only to question-embedding predicates and the counterexamples to the correlation. (The necessity of adding the syntactic qualifier that the PCQC is true only of Case-assigning positions was discussed in §2.3.2.)

§5.1 discusses the need to restrict the PCQC to those predicates which take clausal questions. If concealed questions have propositional denotations and compose with declarative (i.e. proposition-embedding) denotations of predicates like *know*, then, barring other factors, the proposition-denoting DP should be a suitable object of all predicates that take propositions as arguments, such as *believe*. Instead, *John believes the price of milk* is ungrammatical. I will discuss this in terms of Lahiri (2000, 2002), mentioned briefly in the last chapter. Lahiri's theory of Interrogative Raising (IR), which raises question complements of proposition-embedding predicates and leaves a trace with semantic type $\langle s, t \rangle$, faces the same challenge as the PCQC for non-question-embedding predicates. IR will therefore provide a basis for explaining why *believe* is not compatible with CQs. The section concludes by arguing that *care*, which also embeds propositions but does not allow CQs, is more like *believe* than like *know*.

§5.2 takes another look at *decide*, which seems unexceptional in its ability to embed questions, propositions, and CQs. However, Beck and Sharvit (2002), also mentioned briefly in the last chapter, suggest that at least one sense of *decide* does not embed propositions. Therefore we will take some time to reconsider its status with respect to the PCQC. A more careful examination will demonstrate that *decide* is unexceptional.

Finally, §5.3 will take on two predicates, *ask* and *depend*, which really are exceptional in their abilities to accept CQ arguments. The former is a predicate problematic enough for CQ distribution that, as we saw in Chapter 2, the theory of Dor (1992) distinguished PEC predicates from non-NEC predicates solely to account for it. The theory under discussion here must explain why *ask*, though it cannot take a propositional complement, is compatible with CQs. *Depend* does not appear in the table in (2), or in the discussion thereof in Chapter 2, primarily because questions as subjects were specifically set aside by previous authors like Grimshaw (1979) and Dor (1992). Once *depend* is finally under consideration, it can be seen to form much the same kind of counterexample as *ask* does. To explain both of these predicates, we will revisit relational and nonrelational nouns, and it will become clear that, while *ask* and *depend* are compatible with DPs that resemble CQs, their arguments are not actually CQs after all.

5.1. Concealed Questions and Non-Question-Embedding Predicates

While the PCQC comes as a welcome consequence of the theory that CQs denote propositions, the theory also has the unwelcome consequence that predicates like *believe*, which accept propositional complements, should accept CQ arguments. In other words, because the grammar can assign the following propositional denotation to *the price is milk*,

(3) $\iota p_{st} \,.\, [\exists x_e \,.\, p = [\lambda w_1 \,.\, \text{milk costs } x \text{ at } w_1] \wedge \text{C}(p)]$

any $\langle st, et \rangle$ predicate should be able to take it as an argument.[1] Just as *John knows the price of milk* is synonymous with *John knows that the price of milk is \$1.99/gallon* (in a world where the price of milk is in fact \$1.99/gallon), *John believes the price of milk* should mean that John believes that the price of milk is \$1.99/gallon, or at least that it is some price or another. Instead, the sentence is ungrammatical.

In theories in which CQs denote questions or individual concepts, predicates like *believe* are unremarkable; they simply lack a denotation compatible with CQs. We now need to find a new reason that non-question-embedding predicates cannot embed concealed questions. To do so, let us turn to Lahiri (2000, 2002), who also uses $\langle st, et \rangle$ denotations of predicates to interpret their question arguments and who therefore must also explain the incompatibility of *believe* with certain objects.

5.1.1. Lahiri (2000, 2002) and the Quantificational Variability Effect

Berman (1991) observes that, in certain circumstances, adverbs can quantify over the questions embedded as objects by the verbs they ostensibly modify.[2] Thus we have the contrast between the sentences in (4), which are followed by their approximate meanings.

---

[1] Or, at least, any $\langle st, et \rangle$ predicate which assigns Case to its object. *Believe*, as it happens, allows the same kinds of DP arguments we saw with *wonder* in §2.2.3 (*John believes that as well*; *What does John believe?*), so we cannot rule out **John believes the price of milk* on the basis of Case.

[2] Primarily adverbs of quantity such as *mostly* or *to some extent*. See Lahiri (2002) for a thorough discussion of the distinction between adverbs of quantity and adverbs of frequency such as *usually* and *seldom*, and for reasons to think the latter do not give proper QVE readings.

(4) a. Sue mostly remembers what she got for her birthday.
most_x[Sue got *x* for her birthday][Sue remembers that she got *x*]

b. # Sue mostly wonders what she got for her birthday.[3]
most_x[Sue got *x* for her birthday][Sue wonders...?]

The adverb *mostly* can quantify over an interrogative embedded under a verb such as *remember*, giving a meaning that can be roughly paraphrased as above: for most things that Sue got for her birthday, she remembers that she got them. No similar paraphrase is available with the verb *wonder*, and the sentence is ungrammatical. This ability of the adverb to quantify over the embedded question is the *Quantificational Variability Effect* (QVE).

This effect does not hold only for questions and the predicates that embed them. In fact, these adverbs can quantify over DPs as well, as seen in (5).

(5) a. The boys that live around the corner are, for the most part, idiots.
most_x [*x* is a boy that lives around the corner] [*x* is an idiot]

b. Mary mostly likes Beethoven's Fifth Symphony.
most_x [*x* is part of Beethoven's Fifth] [Mary likes *x*]

Adverbs of quantity can quantify over objects that comprise multiple parts. Plural DPs like *the boys that live around the corner* can be broken into parts based on the meaning of the plural, and something like a symphony inherently consists of parts (the various instrumental parts; the key, the tempo, the volume; the movements; and so forth). Thus, *mostly* or *for the most part* can take scope over the entire sentence, with the DP as its restrictor.

Berman's account of the contrast in (4) treats the two questions as different semantic objects: question complements to proposition-embedding verbs are open propositions, while question complements to verbs that exclusively embed questions, as they cannot be propositions, must have question meanings. The QVE adverb quantifies over the individuals in the open proposition, giving meanings like the one in (4a). This not only gives a method for deriving QVE, it also, by making QVE rely on the complement being an open proposition, immediately explains why verbs that cannot embed propositions do not show QVE.

Lahiri (2000, 2002) offers a number of theoretical and empirical criticisms against Berman's approach, which I will not repeat in detail (though one immediately apparent problem is the need to give questions non-uniform meanings in spite of their uniform distribution). His explanation maintains Berman's type distinction between predicates, but also keeps a uniform semantic type and semantic interpretation for questions. That is to say, verbs like *know* seem to be ambiguous between type $\langle st, et\rangle$ (proposition-taking predicates) and $\langle\langle st, t\rangle, et\rangle$ (question-taking predicates), whereas verbs like *wonder* seem to have only the latter type; both Lahiri and Berman make proposition-embedding verbs exclusively type $\langle st, et\rangle$, and question-embedding verbs exclusively $\langle\langle st, t\rangle, et\rangle$. Berman, however, resolves the apparent ambiguity in the semantic

[3] There is a grammatical and felicitous reading of this sentence, a reading which exists in many of the ungrammatical sentences with adverbs that appear in this dissertation. On this reading, *mostly* quantifies not over the question (or its answers) but over events or situations: *At most events e, Sue wonders at e what she got for her birthday*. Such a reading is unsurprising—events and especially pluralities of events can be broken down into smaller pieces, perhaps depending on one's theory of event structure—and not relevant to the issue here.

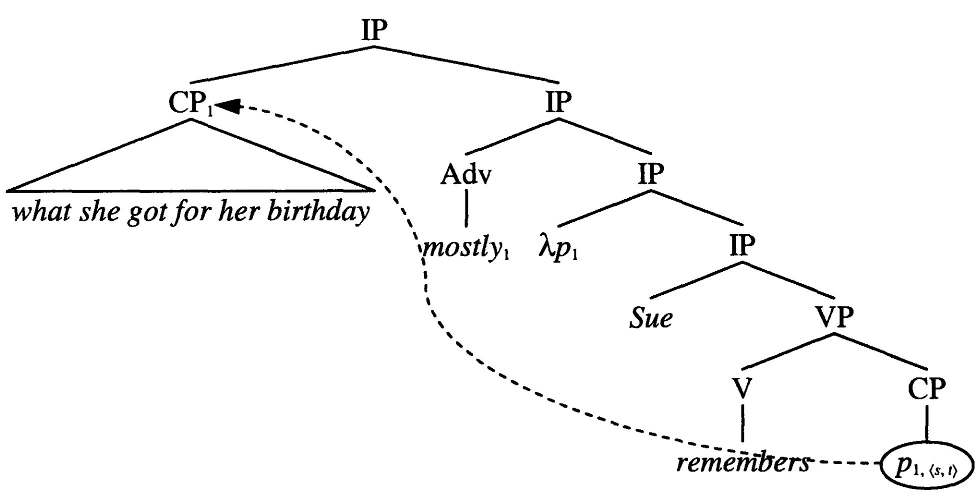
type of *know* by introducing an ambiguity into the semantic type of questions. Lahiri preserves a single ⟨*st*, *t*⟩ type for questions.

One consequence is that, while Berman had the set of individuals that could complete the open proposition over which the adverb could quantify, Lahiri does not have access to such a set. For Lahiri, the quantifiability of questions follows from the creation of a Boolean algebra of answers, which allows the answers to questions to be separated into parts in much the same manner as plural DPs, thus giving the adverb its necessary set. The data I will discuss in this dissertation do not require so thorough a treatment, and I will simplify Lahiri's proposal by treating questions, following Hamblin, as the set of propositions that answer the question. The same basic principles will hold, as a set of propositions can be separated into constituent parts in the same manner as a set of individuals (e.g. the set of boys who live around the corner).

Another, more fundamental consequence of Lahiri's move is that proposition-embedding predicates can no longer compose directly with their question complements due to the type mismatch between the ⟨*st*, *et*⟩ predicate and the ⟨*st*, *t*⟩ complement. Lahiri resolves this mismatch with a rule of *Interrogative Raising* (IR). IR resembles Quantifier Raising (QR) in resolving a type mismatch by moving the uninterpretable object to the top of the tree and leaving behind an interpretable trace. In the case of IR, the raised syntactic object has semantic type ⟨*st*, *t*⟩ (that is, the type of a question), and leaves behind a trace of type ⟨*s*, *t*⟩ (the type of a proposition). The IP of the original sentence is thus an open proposition with a variable over propositions, and lambda-abstraction over the variable gives the IP the type ⟨*st*, *t*⟩ as well. The relation between the two sets of propositions (the raised question and the open proposition) is expressed by the quantificational adverb, which therefore has the type ⟨⟨*st*, *t*⟩, ⟨⟨*st*, *t*⟩, *t*⟩⟩.

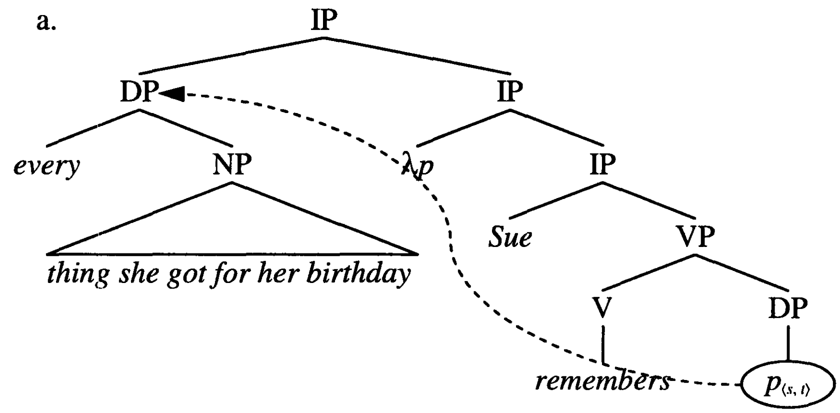
The tree in (6) shows the syntax of QVE.

(6) Sue mostly remembers what she got for her birthday. (= 4a)

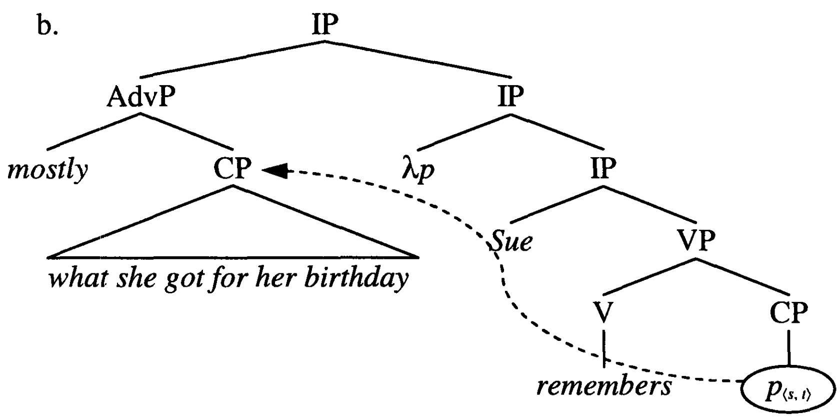


This may not bear an obvious resemblance to the interpretation of CQs, which typically does not require movement of the DP object. But consider the tree in (7a), which does require QR to interpret the quantified CQ (as discussed in §4.3.1.3). To make the analogy visually clearer, compare (7a) to the pseudo-tree in (7b), which is (6) redrawn to give the quantificational adverb a more determiner-like order of arguments, i.e. restrictor, then nuclear scope.[4]

(7) a.



b.



In both QVE and quantified CQ interpretation, a quantifier (*mostly*, *every*) with type ⟨⟨*st*, *t*⟩, ⟨⟨*st*, *t*⟩, *t*⟩⟩ takes a set of propositions as its restrictor (the question *what she got for her birthday*, the derived set *thing she got for her birthday*) and a set of propositions formed by abstracting over an IP with an ⟨*s*, *t*⟩ variable as its nuclear scope.

Bearing in mind the similarity between CQ and QVE interpretation, let us look at the meaning Lahiri gives (6).

(8) Most *p* . [*Ans*(*p*, ⟦*what she got for her birthday*⟧) ∧ C(*p*)] [know(*p*)(sue)]

---

[4] In fact, a typical quantificational adverb differs from a quantifier in just this manner, taking its nuclear scope as its first argument and its restrictor as its second (see Chierchia (***reference needed***):

Italians are usually short = ⟦*usually*⟧(⟦*be short*⟧)(⟦*Italians*⟧) ≈ ⟦*most*⟧(⟦*Italians*⟧)(⟦*be short*⟧).

So the non-standard movement in (7b) is not necessary for interpretation, nor am I proposing it as such. (7b) is presented only to underscore the analogy to (7a). (Readers interested in the actual movement and binding, i.e. that shown in (6), are referred to the discussion in Lahiri (2000), pp. 340-342, and in particular his rule of Unselective Binding. Nota bene: "is a translation of α" in Rule UB should read "is a translation of κ".)

Ans(*p*, Q) is true if *p* is an answer to Q (again, for Lahiri this is defined formally over the Boolean algebra of answers; for the purposes of this dissertation, we can consider *p* an answer to Q iff Q(*p*) = 1).

$C_{\langle st, t\rangle}$ is the contextual variable introduced in the last chapter, used to limit the propositions in the set of answers to Q. Because Hamblin's semantics gives questions the meaning of the full set of propositions that answer the question (rather than just the true ones, as in Karttunen 1977), the denotation of the embedded question in (6) is the set:

⟦*what Sue got for her birthday*⟧ = { λw . Sue got a bicycle for her birthday,
λw . Sue got a puppy for her birthday, λw . Sue got a sweater for her birthday,
λw . Sue got a BMW for her birthday, λw . Sue got a computer for her birthday,
λw . Sue got a pony for her birthday, λw . Sue got a Lear jet for her birthday, ...}

Suppose that Sue got a bicycle, a puppy, and a sweater for her birthday. We certainly don't want *Sue remembers what she got for her birthday* to mean that, for all of the propositions in the above set, she remembers that proposition; this would require Sue to remember all sorts of false propositions (e.g. *Sue remembers that she got a pony for her birthday* would have to be true). Therefore, for a factive verb such as *remember* or *know*, *C* is $\lambda p . [p(w_0) = 1]$, i.e. true of a proposition *p* iff *p* is true in the actual world. The set of propositions that satisfy both *p* ∈ ⟦*what Sue got for her birthday*⟧ and *C*(*p*) are the true propositions in the above set, i.e.

λ*p* [⟦*what Sue got for her birthday*⟧(*p*) ∧ C(*p*)] = {
λw . Sue got a bicycle for her birthday, λw . Sue got a puppy for her birthday,
λw . Sue got a sweater for her birthday}

in the situation described above. *Sue remembers what she got for her birthday* requires only that Sue remember those three propositions (and *Sue mostly remembers...* requires that she remember most of the propositions).

In the absence of an explicit quantifier such as *mostly*, sentences interpretable with IR contain an implicit adverbial. Lahiri correctly hesitates to adopt any analysis in which that adverbial is always universal quantification. That would assign the right meaning to *Sue remembers what she got for her birthday*, which should only be judged true if, for everything that she got for her birthday, she remembers that she got it. However, it will give the wrong truth conditions for *John knows where to get gas*, which is acceptable in situations where there is a place to get gas such that John knows one can get gas there, without it being necessary for John to know every such place. Overall, the quantifier is best left to be determined by context.

5.1.2. An explanation of *believe*

Because IR interprets questions by raising them and leaving an ⟨*s*, *t*⟩ trace as the first argument of the verb, Lahiri's theory makes an incorrect prediction about ⟨*st*, *et*⟩ predicates very similar to the one made by the theory that CQs have ⟨*s*, *t*⟩ denotations. In particular, the CQ theory predicts that all ⟨*st*, *et*⟩ predicates that should allow CQ objects, not just those that allow question complements; Lahiri's theory predicts that all ⟨*st*, *et*⟩ predicates should allow question complements.

The sentence in (9) is ungrammatical, which in most theories of question interpretation can be explained by a semantic mismatch between the ⟨*st*, *et*⟩ predicate *believe* and the ⟨*st*, *t*⟩ question complement.

(9) * Sue mostly believes what she got for her birthday.

If Lahiri is right about IR, this mismatch should be resolvable by raising the question clause, leaving a propositional trace, and quantifying over answers to the question, giving a logical form like the following.

(10) Most p . [$Ans(p$, ⟦*what she got for her birthday*⟧) $\wedge$ C(p)] [believe(p)(sue)]

Paraphrased, that meaning states: for most (relevant) propositions that answer the question "What did Sue get for her birthday?", Sue believes that proposition. This may be a sensible meaning to express, but it is not expressible with *believe* and a question complement.

An anonymous reviewer brought this to Lahiri's attention, and he responds (footnote 10 of Lahiri 2000, p. 340):

> This is not an argument against the account developed here, but an independent question to which I have no answer at this point. Some predicates can take proposition-denoting direct objects as well as question-denoting direct objects, some predicates can take only proposition-denoting direct objects. I assume that such information is present in the lexicon.

What Lahiri assumes to be "present in the lexicon" is, in essence, the s-selection postulated by Grimshaw (1979). This brings us back to a predicate by predicate specification for allowing or disallowing question complements. Indeed, a purely type-driven semantic solution would not work, as it could not specify that *believe* has a type incompatible with an interrogative clause (for the simple reason that *know*, in Lahiri's theory, has the same ⟨*st*, *et*⟩ type that *believe* has). On the one hand, it is inelegant at best to block IR with ⟨⟨*st*, *t*⟩, *et*⟩ predicates like *wonder* via a semantic mechanism and to block it with certain ⟨*st*, *et*⟩ predicates via lexical stipulation. And, on the other hand, s-selection will only stop *believe* from accepting question-denoting predicates, and will not help with a proposition-denoting CQ.

What we need is a semantic solution, and fortunately there is room in Lahiri's theory to use a semantic fact about the lexical entry instead of a syntactic stipulation. We have seen that the contextual variable *C* depends on the embedding predicate, but not in a predictable manner; at least some of the information for determining *C* must be stored lexically. If *believe* lacks this lexical specification, the domain of the quantificational adverb (in IR) or the quantifier (in a CQ) cannot be restricted, and the sentence cannot receive an interpretation.

Alternately, a few semantically oriented methods have been suggested for distinguishing *believe* and *know*, such as that of Égré (2004), who notes that "the fact that a verb like *believe* does not allow interrogative complements constitutes a semantic puzzle relatively understudied in the linguistic literature".[5] Égré postulates the *Factivity Hypothesis*: a predicate that embeds

[5] "Le fait qu'un verbe comme *croire* n'admette pas les compléments interrogatifs constitue une énigme sémantique relativement peu étudiée dans la littérature linguistique." (Égré 2004, p. 189)

propositions can embed questions if and only if it is factive. Some predicates seem to be immediate counterexamples, for which he refines the notion of factivity—he discusses *tell* (*dire*) as a predicate which embeds questions without seeming factive, and *regret* (*regretter*) as a predicate which seems factive without embedding questions. If Égré is correct, his theory may be taken as a more restrictive version of the one suggested above: predicates necessarily determine the restrictor C to be $\lambda p \,.\, [p(w_0) = 1]$, and as question meanings require the restrictor (whether clausal, or the NP within a CQ), they will be incompatible with predicates that do not impose that restriction on their complements.[6]

Égré also notes, and argues against, theories (Russell 1918, Ginzburg 1995, et al.) which take the *that*-clause objects of *know* and *believe* to be different semantic objects, the former being "facts" and the latter being "propositions" (with only facts being derivable from questions, hence the difference in complementation). Without in any way committing such an account, I will note that it, too, would provide a way to restrict CQs to *know*-like predicates and not those like *believe*, as long as CQs can be made to denote facts and not propositions in this sense.

Any of these theories resolve the problem of *believe* + CQ, as well as that of *believe* + Q with IR, via semantic means. Naturally, each would require a more in-depth exploration of the counterexamples and the ramifications before we could adopt it with full confidence. I will not attempt to do so here, and instead I will end this section simply by observing that, whatever semantic explanation turns out to be correct, some semantic explanation certainly seems possible. We may not yet have an understanding of why *believe* does not embed CQs even though their types seem compatible, but we can be guardedly confident that a semantic explanation exists. This allows us to adopt the theory that CQs denote propositions without having to stipulate that CQs appear only where clausal questions appear, and without further worry about *believe*-type predicates as counterexamples.

5.1.3. An explanation of *care*

We saw in Chapter 2 that *care*, though it does embed propositions and questions, does not embed CQs.[7]

(11) a. John cares that the time is 3 pm.
b. John cares what time it is.
c. *John cares the time.

[6] See also Égré (2005), which recasts the hypothesis in terms of veridicality rather than factivity. In neither place does Égré consider *be certain (of)* or *estimates*, predicates discussed in Lahiri (and herein) which seem to need values of C other than $\lambda p \,.\, [p(w_0) = 1]$. Whether such predicates can be explained under his theory, and whether that explanation can then extend to CQs, must be left to further exploration.

[7] Verbs of relevance other than *care* pattern with *know*, though of course for syntactic reasons a CQ cannot be extraposed the way a clause can. Thus:

(i) It matters that it's raining. / That it's raining matters.
(ii) It mostly matters who cheated. / Who cheated mostly matters
(= For most people who cheated, it matters that they cheated.)
(iii) The price of milk matters. / *It matters the price of milk.

Because *care* does embed questions, it seems at first to pose an entirely different challenge than *believe* does. In fact, *care* and *believe* are quite similar: not only does neither allow CQ complements in spite of allowing proposition-denoting arguments, but neither allows QVE.

(12) #John mostly cares who plays for the Red Sox (but doesn't care who plays first base).

(Lahiri, as it happens, does not discuss *care*; nor do Beck and Sharvit (2002) in their discussion of QVE, which we will see in the next section.) The fact that *care*, like *believe*, is not compatible with propositional arguments that incorporate question meanings suggests that the two might have similar solutions.

Interrogative Raising, while it preserves a single denotation for questions (unlike, e.g., Berman 1991), provides two different interpretation mechanisms. For *know*-class predicates, which are unambiguously ⟨*st*, *et*⟩, the semantics (via IR) relates the subject to the answers to the questions; for *wonder*-class predicates, which are unambiguously ⟨⟨*st*, *t*⟩, *et*⟩, the semantics (via function application) relates the subject to the question itself. Therefore, we have entailments like those in (13)-(14) between a sentence with an embedded question and one with an embedded answer to the question. The second premises differ in exactly the same way the predicates differ in the contextual variable *C* that they set:

(13) Mary knows who left.
It is the case that John left.
⊢Mary knows that John left.

(14) Mary is certain who left.
Mary considers it possible/likely that John left.
⊢Mary is certain that John left.

In contrast, no analogous entailment exists for *wonder*, as that predicate neither restricts the propositions in the set denoted by the embedded question nor expresses a relation between the subject and those propositions.[8]

(15) Mary wonders who left.
{It is the case/Mary considers it possible/...?} that John left.
⊢Mary wonders....?

These are direct consequences of the two different methods of interpretation. With *believe*, even if we set aside the ungrammaticality of **Mary believes who left*, we have the same problem as we do with the second premise of *wonder*: the predicate sets no restrictor, and therefore we would not be able to set up a second premise.

Care is factive with propositions, so we might expect the same entailment to hold for *care* as holds for *know*. Nevertheless,

[8] It may be an entailment that *Mary wonders if/whether John left* (and see Beck and Sharvit (2002), discussed in the next section, for a subquestion theory of embedded question interpretation). The entailment that does not exist is one relating *Mary* to the proposition *that John left*. Even the apparent near-paraphrase "want to know", alluded to in §3.2.3, produces the wrong entailment: if Mary wonders who left and if it is the case that John left, it does not exactly follow that Mary wants to know that John left.

(16) Mary cares who left.
It is the case that John left.
⊭Mary cares that John left.

it does not hold. In particular, one cannot care that P without knowing that P, e.g. *Mary cares that John left* entails (or perhaps presupposes) that she knows that John left; but the premises in (16) are compatible with Mary not knowing that John left, so the conclusion that she cares that he left does not necessarily follow. Nor can it be made to follow with any other second premise; in fact, *care* differs from *know* and *be certain* in this respect, and instead resembles both *wonder* (though the conclusion happens to be grammatical with *care*) and *believe* (though the first premise happens to be grammatical with *care*). Therefore, question-embedding *care* should, like *wonder*, relate the subject to the object question and not to its answers; intuitively, it does just that.

The solution this suggests, and the solution I propose, is that *care* is in fact two different predicates, one that embeds propositions the same way that *believe* does and one that embeds questions the same way that *wonder* does. Neither sense of *care* is like *know*, so we no longer predict that *care* will allow either CQ complements or QVE readings. $Care_{\langle st,\, et\rangle}$ doesn't allow CQs because, like *believe*, it lacks the *C*-assigning ability necessary for semantic composition with question complements; $care_{\langle\langle st,\, t\rangle,\, et\rangle}$ doesn't allow CQs because, like *wonder*, it cannot semantically compose with a propositional object.

5.1.4. Two down, three to go

We have seen, in this section, that neither *believe*-like predicates nor the predicate *care* poses a problem for a theory in which concealed questions have the same meanings as, and therefore should have the same distribution as, propositions. In each case, we had a predicate which, though it should have been semantically compatible with a CQ meaning, does not take CQs as arguments.

In the remainder of this chapter, we will look at verbs with the opposite problem: though they should be incompatible with CQ meanings, they nevertheless do take CQ arguments. The next section looks at a particular approach in which *decide* is argued not to embed propositions. Following this, we will consider *ask* and *depend*, predicates for which the inability to accept propositional arguments is unquestionable.

5.2. Concealed Questions and Apparent Non-Proposition-Embedding Predicates

According to the data presented so far, *decide* presents no problem for the theory that CQs denote propositions. It does embed both propositions and questions, and it allows CQ complements. (Additionally, as predicted by Lahiri, it allows QVE.)

(17) a. The committee decided that Fritz would be admitted.
b. The committee (mostly) decided who would be admitted.
c. The committee decided the price of milk.

If there were nothing else to be said about *decide*, we could immediately move on to *ask* and *depend*. However, Beck and Sharvit (2002) offer new data intended to suggest that *decide* has at least one sense whose argument must be a question and not a proposition, and if their analysis of the data is correct, we will have a predicate which composes with some proposition denotations (i.e. CQs) but not others (i.e. clausal propositions). This section begins with a brief overview of their theory and presents their data and conclusions; subsequently, we will see that their data does not actually require a non-proposition-embedding *decide*.

5.2.1. The challenge from Beck and Sharvit (2002)

Beck and Sharvit (henceforth B&S) challenge Lahiri's theory of Interrogative Raising and suggest that adverbs which exhibit QVE quantify not over the propositional answers to the embedded question, but over subquestions of the question. Using Lahiri's example, *Sue mostly remembers what she got for her birthday*, B&S assign the sentence the meaning:

(18) Most Q . [$Q \in$ Part([[*what she got for her birthday*]])] [know(Q)(sue)]

where Part(Question) is a set of subquestions of Question—in particular, the set of *whether* questions whose answers determine an answer to the question. For *what Sue got for her birthday*, the set will be the denotations of the questions *whether Sue got a bicycle for her birthday*, *whether Sue got a puppy for her birthday*, *whether Sue got a Lear jet for her birthday*, and so on.

In B&S's theory, *know* does compose directly with an object of type $\langle st, t\rangle$. Of course, they require a variant of *know* that composes with propositions, so for *know*—and most other predicates—the proposed correlation between embedding propositions and embedding CQs can be maintained regardless of whether Lahiri or B&S are correct about QVE.

However, they do observe two points of data concerning verbs compatible with QVE but not with propositional meanings. Because these verbs also allow CQs as arguments, the challenge for Lahiri's theory of IR extends to the proposal that CQs are propositions. B&S's first point concerns verbs of dependency, which can have questions but not propositions as subjects, but nevertheless allow QVE, as seen in (19b) (≈ B&S's (20)/(21b)).

(19) a. * That John will be admitted depends exclusively on this committee.
b. For the most part, who will be admitted depends exclusively on this committee. (= *For most people, it depends exclusively on this committee whether they will be admitted.*)

Again, as CQs also appear to be legitimate subjects for *depend*,

(20) The price of milk depends exclusively on the decisions of the Dairy Council.

a defense of propositional meanings for CQs must explain how they can be compatible with *depend*. Let us set this issue aside for the time being and return to it in the final section of the chapter, when we discuss *ask*.

This brings us to *decide*. We saw that it appears to present no trouble for either Lahiri's theory or for the theory of CQs as propositions. But B&S observe that it seems to have different senses when embedding propositions and questions. In sentences like the ones in (17), this is not necessarily apparent. However, when *decide* is used with the simple present with a generic meaning (i.e. what B&S call "generic tense" on page 112), a proposition seems anomalous, though a question does not.

(21) a. ?The committee decides that Fritz will be admitted.
b. The committee decides who will be admitted. (= B&S (26))

And *decide* with a proposition does not adequately paraphrase QVE with generic *decide*, unlike *decide* with a *whether*-question:

(22) a. The committee mostly decides which candidates will be admitted.
b. =For most candidates, the committee decides **whether** they will be admitted.
c. ≠For most candidates, the committee decides **that** they will be admitted.
or For most candidates that will be admitted, the committee decides **that**...
(=B&S (25), (27), emphasis added)

B&S demonstrate (in §3.2 of their paper) that the paraphrase in (22c) is inadequate as a result of the exhaustivity of the embedded question. Pragmatically, *decide* often requires strong exhaustivity—the subject of *decide* must not only choose which answers to the complement question will be made true, but must actively reject the other possibilities. In the case of deciding who will be admitted, for instance, the subject typically must make a decision for each candidate *x*, regardless of whether *that* x *will be admitted* is true or false. In the paraphrases in (22), using a *whether*-question allows quantification over the entire set of candidates, giving a strongly exhaustive meaning, while the paraphrase with *that they will be admitted* does not cover the set properly: quantifying over *most candidates that will be admitted* means that the rejected candidates aren't included in the decision, which provides only a weakly exhaustive answer to the question and not the strongly exhaustive answer preferred by *decide*.[9]

The concern of B&S that Lahiri (2000) "counts atomic parts of complete answers to a question, and for the Ans-strg [i.e. strongly exhaustive] interpretation would need to count atomic parts of Ans-strg instead of (as in his theory) Ans-wk" (p. 120) is entirely valid. Fortunately, Lahiri (2002, §3.6) shows that the theory of Interrogative Raising can do exactly this. Consequently, the proper paraphrase for *The committee mostly decides which candidates will be admitted* is *For most propositions* p *of the form "that candidate* x *will be admitted", the committee will decide* p *or* ¬p *(as appropriate).*

So as it happens, *decide* does not provide evidence for or against either Lahiri's or B&S's theory; the correct meaning for *decide* with QVE can be derived in both. But our real concern here is not QVE but CQs, and if the above data demonstrates, as B&S suggest, "a semantic

---

[9] Beck and Sharvit offer the following (example 49, cited to Irene Heim, p.c.):

(i) On Monday we mostly decide who won't be accepted. On Wednesday we mostly decide who will be accepted.

In this context, the embedded questions must have a weakly exhaustive reading: on Monday, the decisions made by the committee are (mostly) the propositions of the form *that* x *won't be accepted* that they want to be true, but the committee does not have to decide on Monday that all other propositions of this form will not be true; similarly for Wednesday. In fact, for the sentence in (i), propositional paraphrases like the one in (22c) are entirely correct: *for most candidates who won't be accepted, we decide on Monday that they won't be accepted; for most candidates who will be accepted, we decide on Wednesday that they will be accepted.*

difference between proposition embedding *decide* vs. question embedding *decide*" (p. 112), then *decide* should fail to accept CQ objects for exactly the reasons that the non-CQ-embedding *care* does, as described in the previous section. That is to say, because *care* has distinct proposition embedding and question embedding senses, it is not compatible with CQs; if *decide* also has two distinct senses of this sort, then it, too, should not be able to embed CQs. Nevertheless, it can.

Moreover, though B&S do not discuss CQs, a propositional paraphrase for an embedded CQ on analogy with (22) also seems inadequate.

(23) a. The Council decides the price of milk.
b. =The Council decides **what** the price of milk will be.
c. ≠The Council decides **that** the price of milk will be $1.99/gallon.

The exhaustivity explanation used above does not work here: (23c) implicates that, for all prices that are not $1.99/gallon, the Council does not decide that the price of milk will be that price (unlike the explicit quantification over *most students who were admitted*, which if anything implicates that the committee did not make the decisions for the other students). We might therefore conclude that a CQ object of *decide* must have a question meaning and not a propositional meaning.

The next subsection will explain the felicity contrast in (21) in terms of independent facts about the simple present, thereby eliminating the need to postulate separate proposition- and question-embedding senses of *decide*. The subsection following will explain the inadequacy of the paraphrase in (23) in terms of independent facts about world-dependency and question interpretation.

5.2.2. One *decide* or two?

Before explaining the data given in the previous section, we should note that *decide* does in fact have at least two senses, though not necessarily the different senses suggested by Beck and Sharvit.

(24) a. The committee decided that Fritz would be admitted to USNDH.
b. #The committee decided that Fritz had been admitted to USNDH.
c. The committee decided whether Fritz would be admitted to USNDH.
d. The committee decided the price of milk.

(25) a. Fritz decided that he would be admitted to USNDH.
b. Fritz decided that he had been admitted to USNDH.
c. #Fritz decided whether he would be admitted to USNDH.
d. #Fritz decided the price of milk.

The *decide* of (25) has a sense of deduction—Fritz drew the conclusion from the evidence (or possibly just from wishful thinking) that he would be admitted. This sense does not allow questions or CQs; it is compatible with a complement whose time precedes the decision time; it sets no requirement on the subject's relation to the complement true; and it is not at all factive (as Fritz can draw any conclusion he likes without that conclusion necessarily being true). In contrast, the *decide* of (24) has the sense of choosing, of making a decision—the committee chose that Fritz would be admitted, who would be admitted, or what the price of milk would be.

This sense of *decide* allows propositions, interrogatives, and concealed questions; the time of its complement must follow the decision time; it requires that the subject has the power to make the complement true; and it is factive.[10]

As a brief digression: these latter two facts about the come-to-a-decision sense of *decide* recall Copley (2002), who discusses a number of different future-oriented sentences:

(26) a. *Simple futurate*: Sandy leaves tomorrow.
b. *Progressive futurate*: Sandy is leaving tomorrow.
c. *Future*: Sandy will leave tomorrow.
d. *Progressive future*: Sandy is going to leave tomorrow.

She analyzes all four as presupposing the existence of a *director*: an individual or force with the power and the desire to bring about the event. In general, the director of a future-oriented proposition need not be syntactically determined; thus, Sandy might be the director of the sentences in (26) if she has determined the plan for her to leave, but they are also compatible with some other person having made the plan. (Copley's sentence *The Red Sox are playing the Yankees tomorrow* shows an event in which the individual with the power and desire to bring it about, namely Major League Baseball, is determined by context and not the syntax of the sentence). A sentence with *decide* has the meaning of its embedded future-oriented sentence with the added information that the embedded sentence's director is the matrix subject. Thus, all of the following sentences:

(27) a. Kim decided that Sandy leaves tomorrow.
b. Kim decided that Sandy is leaving tomorrow.
c. Kim decided that Sandy will leave tomorrow.
d. Kim decided that Sandy is going to leave tomorrow.

presuppose that someone directs the event of Sandy leaving, and assert that it is Kim who directs the event, i.e. has the desire and power to cause Sandy to leave tomorrow. The reader is referred to Copley's dissertation for more details of the differences in the four kinds of future sentence

[10] A few caveats. First, there are circumstances in which one may seem to make a decision about the past (a judge deciding that a defendant had been in the wrong, for instance). One might imagine (24b) describing a situation analogous to the real-life situation somewhat erroneously described in (i):

(i) In December of 2000, the Supreme Court decided that George W. Bush had been elected in November.

However, even in (i), the court was essentially choosing which possible worlds corresponded to the actual world: those in which Bush had been elected a month before or those in which he had not. So the situation still fundamentally involves a choice about present possible worlds, and not a choice (or deduction) about the past.

Second, *decide*'s factivity requires an added "if nothing changes..." assumption. If the committee decides that Fritz will be admitted to USNDH, then Fritz will be admitted, though if the committee decides that Fritz will be admitted and then Fritz withdraws his application, or the university cuts the department's funding—that is, if the committee loses the power to make the complement come true—then it can be the case that Fritz will not be admitted.

Incidentally, note that the decision verb *determine* has two senses as well, though one is the "choose" sense that *decide* has and the other is a "find out" sense. In the case of *determine*, both senses embed questions and CQs—*Fritz determined the price of milk* (i.e. he found out what the price of milk was), *The committee determined the price of milk* (i.e. they set what the price of milk would be)—so distinguishing them is less important.

(and for a more complete discussion of directors and of the inertial modal force behind the factivity).

At any rate, Beck and Sharvit's conclusions about a "different sense" of decide refers to a nuance within the "make a decision" sense just discussed, so we can set aside the non-question-embedding "deduction" sense. Now, repeating B&S's data designed to illustrate the two senses of *decide*:

(28) a. ?The committee decides that Fritz will be admitted.
b. The committee decides who will be admitted.

This shows, according to B&S, that decision verbs "seem to be used in a different sense when embedding a question than when embedding a proposition" (p. 112), which is the claim that poses a challenge to the current theory of CQ interpretation.

But does the contrast in (28) really indicate two different senses of *decide*? I believe that the anomaly of (28a) has a much more mundane source: it results from the pragmatics of the generic use of the simple present, which requires that the action be repeated (or at the least repeatable). So while a generic requires repeated or habitual action, deciding that Fritz will be admitted can (under usual circumstances) only be done once. Therefore, the proposition expressing that Fritz will be admitted makes a poor argument for generic *decide*, just as other one-time events are anomalous when expressed with a generic simple present.

(29) a. #The rose bush I planted in 2003 dies.
b. #A powerful hurricane destroys the Pensacola Seaside Hotel.

Simply by replacing the unique event with something repeatable—for instance, a proposition with an indefinite—the generic with *decide* + a proposition improves markedly.

(30) a. ?The network decides that *Star Trek* will be cancelled.
b. (Every few weeks,) the network decides that a show will be cancelled.

Though a given show can only be cancelled once under ordinary circumstances, the decision "that *x* will be cancelled" can be made repeatedly for different values of *x*. In fact, even (28a) and (30a) can be improved:

(31) a. Every year, the committee decides that Fritz will be admitted, and every year, the administration overrules them.
b. About twice a season the network decides that *Star Trek* will be cancelled, but the outrage from the fans always makes them change their mind.

Reversing the decision removes the unrepeatability of making the decision.

B&S, because their theory uses *whether* subquestions, reduce the felicitous sentence *The committee decides who will be admitted* to a set of sentences such as *The committee decides whether Fritz will be admitted.* One might expect, based on the above discussion, that this latter sentence would be as infelicitous as (28a), as it too describes the one-time action of deciding whether Fritz will be admitted. And in fact, forcing a generic reading of the sentence does create exactly the same infelicity.

(32) # In general/Periodically/On Tuesdays, the committee decides whether Fritz will be admitted.

If the generic reading is not forced and if a future time is salient, the sentence can be interpreted with a futurate meaning of the sort exemplified by the simple present sentence in (26a).

(33) (Some time next week,) the committee decides whether Fritz will be admitted.

That is, roughly following Copley (2002), someone has a plan in which, some time next week, it will be the case that the committee is deciding at that time whether Fritz will be admitted.

But Beck and Sharvit's claim is based on the generic reading of the simple present, not on the futurate reading. Moreover, the infelicity of (34), which has a simple present with futurate interpretation and a propositional complement,

(34) # (Some time next week,) the committee decides that Fritz will be admitted.

is easily explained by the pragmatic restriction on futurates that one cannot plan something out of one's control. One can plan for the committee to make a decision about Fritz next week, but one can't plan the actual decision. Thus, a plan which involves knowing the outcome of a decision in advance is as infelicitous as Copley's sentence in (35), which involves planning the outcome of a baseball game in advance.

(35) # The Red Sox are defeating the Yankees tomorrow.
(cf. *The Red Sox are playing the Yankees tomorrow.*)

Both (34) and (35) improve in situations where "the fix is in": where a corrupt gambler has paid the Yankees to deliberately lose their game, or where a university official has ordered the committee to accept Fritz so that his father will make a sizeable donation. In these situations, the particular outcome can be part of the plan.

So contrary to what B&S suggest, it seems that there are not two different senses of decision-making *decide*, one of which takes propositional complements and cannot be used generically, the other of which takes only interrogative complements and can be used generically. There is only one *decide* which, as it takes both interrogative and propositional complements, allows QVE as Lahiri predicts and allows CQ complements. Used in the simple present, the predicate simply has either the restriction that its complement be repeatable (as with any generic) or the requirement that its complement be plannable (as with any futurate).

5.2.3. The inadequacy of propositional paraphrases

So it seems that propositional complements with *decide* really are generally possible, though they happen to by and large not be possible with the generic interpretation of the simple present. But in (36), repeated from (23), why does the paraphrase with an embedded proposition fail to capture the right meaning?

(36) a. The Council decides the price of milk.
b. =The Council decides **what** the price of milk will be.
c. ≠The Council decides **that** the price of milk will be \$1.99/gallon.

In other words, if (36a) receives its semantic interpretation via ⟦*decide*⟧ taking a propositional meaning as its argument, we might want it to have the same meaning as (36c), which it does not. The problem here is not the infelicity of simple present *depend* with a proposition, as deciding that the price of milk will be \$1.99/gallon is a repeatable action.

We can easily explain the difference in meaning in light of the previous section. While (36c) does not have the anomaly of *decide* with a non-repeatable action, it is true only if the Council always (or habitually, or repeatedly) picks the same price for milk, which need not be the case in (36a). What makes the particular propositional paraphrase in (36c) wrong is that the proposition denoted by the CQ is not really *that the price of milk will be \$1.99/gallon* or any other single, constant proposition. Instead, the CQ denotes different propositions at different times. This is no different than a CQ complement of other verbs used generically, such as *know*:

(37) a. Kim always knows the price of milk.
b. ≠Kim always knows that the price of milk is \$1.99/gallon.

The index-dependent nature of the proposition comes from the index dependence of the contextual variable *C*. Remember that, though we generally left out the world argument of *C* in the last chapter, the proper denotation of *the price of milk* is the following.

(38) $[\![\textit{the price of milk}]\!]^w = \iota p_{st} \,.\, [\exists x_e \,.\, p = [\lambda w_1 \,.\, \text{milk costs } x \text{ at } w_1] \wedge C(w)(p)]$

Hence, while the price of milk might be \$1.99/gallon at the moment, the CQ $[\![\textit{the price of milk}]\!]^w$ in (36a) and (37a) should not be paraphrased with the proposition *that the price of milk is \$1.99/gallon*, but rather something like:

(39) at each index w, the proposition p such that...
(a) p is of the form $[\lambda w_1 \,.\, x$ is the price of milk at $w_1]$ for some x, and
(b) p satisfies a contextual restriction C **at w**

With *know*, the variable represents the set of true propositions at a given index, so that *the price of milk* denotes, at a given index w, the proposition which (a) expresses a price of milk and (b) is true at w. This is a different proposition at different indices, which makes the paraphrase in (37) incorrect.

Similarly, with *decide*, the variable represents the set of propositions that the subject directs at w in the sense of Copley (2002), the propositions such that the subject wants them to be true and has the power to make them true. Because the subject of *decide* may want a different proposition to be true at different times, the CQ object of *decide* also denotes a different proposition at different indices. This makes the sentence compatible with the committee deciding, at different times, a different "price of milk" proposition. Consequently, the theory presented here has no trouble interpreting CQ objects of *decide* as propositions, in spite of the apparent consequence of B&S's arguments that interpreting the complement of *decide* as a proposition will give the wrong truth conditions.

We have seen in this section that, in spite of Beck and Sharvit's data, *decide* does embed propositions and questions with equal facility, and interpreting an embedded question or concealed question by having *decide* compose with a propositional meaning is unproblematic.

5.3. Non-Proposition-Embedding Predicates and Apparent Concealed Questions

The final two predicates to discuss, *depend* and *ask*, both allow questions but not propositions in their argument positions. Both verbs should be incompatible with proposition-denoting CQs, yet both verbs seem to allow CQs, *depend* in its subject position, *ask* in its object position.[11]

(40) a. *How much milk costs* depends on how much milk dairy cows produce.
  b. * *That milk costs $1.99/gallon* depends on how much milk dairy cows produce.
  c. *The price of milk* depends on how much milk dairy cows produce.

(41) a. Sam asked *how much milk costs.*
  b. * Sam asked *that milk costs $1.99/gallon.*
  c. Sam asked *the price of milk.*

These are certainly not marginal uses of concealed questions; indeed, sentences with *ask + CQ* are among the most cited uses of concealed questions. If *the price of milk* denotes the same proposition as *that the price of milk is $1.99/gallon*, these facts are quite mysterious; in contrast with *decide*, the ungrammaticality of the paraphrases with propositions is not an accident of tense or aspect, but a fundamental incompatibility of *ask* and *depend* with propositions.

Faced with the claim that *decide* could embed CQs but not propositions, I defended proposition denotations for CQs by arguing that *decide* actually could embed propositions. Faced with the same claim about *ask* and *depend*, I will defend proposition denotations for CQs by arguing exactly the opposite: these verbs actually cannot embed concealed questions, and *the price of milk* in the above sentences is not a CQ. Thus, DP arguments of these verbs do not denote propositions as they do when used as CQs.

It may seem strange to claim that *the price of milk*, which has a concealed question interpretation in argument positions that allow questions, is not a CQ in the above sentences. What makes this claim justifiable is that neither *ask* nor *depend* can have as its argument the full

[11] *Ask* does allow *that*-clauses in object position, but only those which are embedded commands or requests, such as *Sam asked that the time of the meeting be changed*, and not those which are propositions. See footnote 3 in Chapter 2.

Depend also accepts questions but not propositions in object position. However, a DP object of *depend* is not really a concealed question. Consider *this committee* in Beck and Sharvit's sentence in (19b):

(i) For the most part, who will be admitted depends exclusively on this committee.

While one might be able to interpret *this committee* as something like an identity question—who will be admitted might depend on "who this committee is" in the sense of who serves on it, though this interpretation is a stretch—it's not the case that the DP *must* be interpreted as an identity question. The more salient paraphrase is that admittance depends on *what this committee decides*. In fact, *this committee* can't even really be a CQ: *Sam knows this committee* has the irrelevant "is friends with" reading, but not the "can provide the identity of" reading. For this reason, the discussion of *depend* here and throughout will concern only its subject argument.

range of DPs that can have CQ meanings. In fact, the acceptable DPs for each verb fall into categories familiar from Chapter 4:

(42) a. Sam knows {the price of milk/the height of the building}.
b. Sam knows {the capital of Vermont/the governor of California}.
c. Sam knows {my favorite wine/the person responsible/the city I visited last week}

(43) a. Sam asked {the price of milk/the height of the building}.
b. Sam asked {the capital of Vermont/the governor of California}.
c. #Sam asked {my favorite wine/the person responsible/the city I visited last week}

(44) a. {The price of milk/the height of the building} depends on a few factors.
b. #{The capital of Vermont/the governor of California} depends on a few factors.
c. #{John's favorite wine/the person responsible/the city I will visit next week} depends on a few factors.

While *know* allows any CQ as its argument, *ask* does not; it allows only DPs headed by relational nouns. Nor does *depend*, which allows only DPs headed by abstract relational nouns.

The difference in distribution may be easy to describe in these terms, but any theory seeking to explain it faces a number of challenges. We will look first at these challenges, after which we will sketch out a possible solution for each predicate.

5.3.1. The difficulties of the data

What denotations do we want the DP object of *ask* and the DP subject of *depend* to have? We know the DPs can have propositional denotations; but if they did denote propositions, with a mechanism (type-shifting, movement, etc.) allowing the predicates to compose with these denotations—we would be left with the dual mystery of, first, why other proposition-denoting DPs (e.g. *the city I will visited last week*) cannot fill these argument positions, and second, why propositional CPs cannot do so. Similarly, if the predicates were made compatible with another denotation type available to these DPs such as *e* or $\langle s, e\rangle$, we would have no way of explaining why every DP with that type could not appear in these argument positions.

So we do not want to make the predicates compatible with the possible DP types; but we also do not want to give question denotations to the DPs to make them compatible with the predicates. Keeping DPs such as *the price of milk* and *the governor of Vermont* from having question denotations is at the heart of the semantic explanation for their compatibility with *know* but not *wonder*; once *the price of milk* can be interpreted as a question when the object of *ask* or the subject of *depend*, it becomes mysterious why it cannot receive this interpretation when it is the object of *wonder*.

Between the limited set of DPs which can appear in these argument positions and the limited set of non-proposition-embedding predicates in whose argument positions these DPs can appear, we have eliminated a large number of the possible types for the DPs' denotation. In general, using any type or mechanism available to DPs outside the set of possible arguments of *ask* or of *depend* will fail to distinguish between the arguments possible and those not possible. Instead, let us return to what does semantically distinguish *the price of milk* from *the governor of Vermont*, and what distinguishes these from *the city I visited last month*. Relational nouns like *price* and *governor*, unlike other nouns or noun phrases, have $\langle e, et\rangle$ and $\langle e, \langle st, t\rangle\rangle$ denotations available; *price* and *governor* differ not in denotation type but in the nature of their ⟨*e*, *t*⟩ denotations, the former's being constant across worlds and times, the latter's being world-dependent.

Using these distinctions, however, proves difficult. First consider the type difference in possible DP complements of *ask*. While the nouns differ in type, this difference is already invisible in the NP, a compositional step before the creation of the DP that the verb takes as its argument. That is, while *governor* and *city* can be distinguished by type, the ⟨*e*, *t*⟩ and ⟨*se*, *t*⟩ denotations of *governor of Vermont* are compositionally indistinguishable from the denotations of *city* or *picture (on Jordan's wall)* or any other nonrelational noun or noun phrase, and the ⟨*st*, *t*⟩ denotation is similarly indistinguishable from the denotation of any other CQ's noun phrase.[12] Similarly, while the ⟨*e*, *t*⟩ meanings of *price* and *governor* can be distinguished by their index-independence, the ⟨*e*, *t*⟩ meanings of *price of milk* and *governor of Vermont* are both small (perhaps singleton) sets; other, derived meanings of *price* and *governor* have no argument position for *milk* or *Vermont* to fill.

Note too that simply having an ⟨*e*, *et*⟩-denoting head is not sufficient to make a DP a possible argument of *ask*:

(45) a. #Kim asked me [the governor Sandy met last night].
     b. #Kim asked me [the governor Sandy knows].

Governor in (45a) is, in the theory presented in the last chapter, the ⟨*e*, *t*⟩-denoting variant; the CQ sense of the DP with proposition-embedding verbs (e.g. *Kim told me the governor Sandy met last night*) comes from the modification of $governor_{et}$ by the relative clause. Nevertheless, the ⟨*e*, *t*⟩ denotation derives from the relational noun denotation (via the existential closure type shifter), and therefore this DP has an ⟨*e*, *et*⟩ denotation at its foundation. Similarly, the Heim-ambiguity DP in (45b), anomalous in this context with either Reading A or Reading B, also derives ultimately from the RN meaning.

Unfortunately, this leaves us with a dilemma: even the meanings unique to RNs like *price* and *governor*, useful in explaining their distribution as CQs, seem unhelpful in explaining *depend* and *ask*. I am not sure that any solution to this puzzle is a good solution; in the rest of this section, I will sketch one possible solution for *depend*, followed by one for *ask*.

5.3.2. Toward a semantic solution for *depend*

Setting aside irrelevant senses (e.g. one which asserts that the subject in some way needs the object: *children depend on their parents*), we will be concerned with the *depend* that relates a subject question to an object question. With this meaning, *depend* asserts that the answer to the object question in any given possible world is necessary and, with perhaps some other information, sufficient to determine the answer to the subject question.

This is spelled out in the simplified meaning of question-embedding *depend*, adapted from Lahiri's (2002 : 226ff) discussion of the one proposed in Karttunen (1977 : 10, fn. 6):

(46) $[\![depend\ (on)]\!](w_0)(F_Q)(K_Q) = \exists g_{\langle Q, Q\rangle} . \forall w_1\ w_0 \mathbf{R} w_1\ [g(F^1) = K^1]$ $\quad (Q \equiv \langle st, t\rangle)$

[12] Though, of course, syntactically distinguishable from ⟨*st*, *t*⟩-denoting CPs (in other words, questions).

K and F represent the subject and object questions, respectively, with Q^n being the set of true answers to a question Q in a world w_n: $Q^n = \{p: p \in Q \wedge p(w_n)\}$; **R** is an accessibility relation. g is a function from sets of propositions to sets of propositions, so that "the denotation of the question in the subject position of *depend on* is determined in all possible worlds by the denotation of the question in object position" (Karttunen 1977: fn 6). The function g maps a set of propositions which answer the object question F to a particular set of propositions which answer the subject question K, so that any world w_1 in which the set of true answers to the object question is X, the set of true answers to the subject question will necessarily be $g(X)$.

Suppose now that *depend* allows ICs as subjects. This prevents RNs with relative clauses such as *the price John knows*, where the relative clause forces a propositional meaning for the DP and thus precludes an IC meaning, from being the subject of *depend*. For the verb to compose with its subject, it is not necessary for the IC meaning to shift to a question meaning whose answers would be evaluated in possible worlds. Because an IC already has world-dependence built into it, *depend* could instead use a different kind of function than g to relate the subject and object.

(47) $[\![depend\ (on)]\!](w_0)(F_{\langle st,\,t\rangle})(x_{se}) = \exists h\ .\forall w_1\ w_0\mathbf{R}w_1\ [h(F^1) = x(w_1)]$

Rather than using $g \in D_{\langle\langle st,\,t\rangle,\,\langle st,\,t\rangle\rangle}$ to correlate the answers to the object question in w_1 and the answers to the subject question in w_1, *depend* with a DP subject uses a function $h \in D_{\langle\langle st,\,t\rangle,\,e\rangle}$ to correlate the answers to the object question in w_1 and the value of the IC in w_1.

We don't want *depend* to accept just any IC as its subject, so let us set a presupposition on h that only the right ICs can meet.

(48) Presupposition on h, first attempt:
$\forall w_1\ .\ [h(Q^1) \in y(w_0)]$, where y is the $\langle s, et\rangle$ meaning of the subject's head noun

The A of B depends on Q asserts that the same set of true answers to Q maps to the same individual in all possible worlds w_1; the presupposition in (48) ensures that each of these individuals is an A in w_0 as well as in w_1. Thus, *the price of milk depends on how much milk dairy cows produce* might be paraphrased "Which price is the price of milk depends....", and while this paraphrase works for an NP that denotes the same set in all worlds, it fails for one that does not:

(49) #Next election, the governor of California will depend on how well Arnold has been leading the state.

If grammatical, (49) would mean that the answer to the question "how well has Arnold been leading California?" in any given world determines the individual who is the governor of California after the next election in that world. If we take into account the restriction on the mapping function h described in (48), the sentence would mean that that answer determines which (actual) governor is the governor of California. But the individual who is the governor of California in many of those possible worlds is not, currently, a governor, and thus cannot be an answer to the question "which governor would be the governor of California?" In fact, the only kind of IC suitable to be the subject of *depend* is one headed by a noun whose $\langle e, t\rangle$ denotation is constant across all worlds—exactly the result we want.

For the most part this approach achieves the right results, but it is not the final word on the matter. In §4.2.3 we saw how we might derive the $\langle e, t\rangle$ meaning of an ARN from its $\langle e, et\rangle$ meaning, but if that derivational mechanism is a semantic operation, it would be odd to have it apply in the pragmatics; nor was the shifting operation of such simplicity that we could reasonably fold it into the pragmatic restriction. Moreover, the pragmatic nature of the restriction also predicts that setting up a context in which the $\langle e, t\rangle$ denotation of a CRN is constant across (relevant) worlds will improve it as the head of the DP subject of *depend.* This prediction is wrong, as the following context demonstrates:

(50) Several friends are playing a board game in which one person, playing the prime minister of a country, appoints the other players to various governmental positions, including three ministers: the Minister of Finance, the Minister of Security, and the Minister of Foreign Affairs. The prime minister, having assigned the other roles to players, is left with Chris, Sam, and Alex to be the three ministers. She announces:
#The Minister of Security depends on how much money you each bribe me with.
(cf. *Who the Minister of Security will be* depends on how much money...)

In all possible worlds accessible from the world described, including of course that world itself, the set of ministers is {Chris, Sam, Alex}. This should satisfy the restriction on h, but the sentence is still anomalous. It seems that the lexical difference between *price* and *minister*, and not the facts of the situation, determine the grammaticality of the sentence.

Instead of using in the restriction on h the fact that $\langle se, t\rangle$ denotations derived from ARNs are index-independent, we can go back a step to the cause of that independence. That is, we can base the presupposition on h on the fact that ARNs and not CRNs are built from scales, as follows.

(51) Presupposition on h, revision:
$\exists y_{\langle s, et\rangle} \,.\, \forall w_1 \,.\, [h(Q^1) \in y(w_1)]$, where $y(w_1)$ is based on a scale.

How the latter clause is formalized depends on the exact relation between $\langle e, t\rangle$ sets and their scales—for instance, it might be written as "...where $y(w_1)$ has an ordering mechanism".

Though more work remains to bring this approach to completeness, I believe it to be a step in the right direction.[13]

[13] Another option is to change the denotation of *depend* in (47) so that its second argument, i.e. its subject, has the type $\langle s, d\rangle$ instead of $\langle s, e\rangle$. *Depend* then expresses a correlation in all worlds between the answers to its object question and the degree denoted by its subject DP. Equivalently, the presupposition on h could be as simple as requiring that its range be degrees: $\forall Q_{\langle st, t\rangle} \,.\, h(Q) \in D_d$. Either solution requires recognizing degrees as distinct from individuals, a move I hesitated to make in §4.2.3 and one I still hesitate over.

There are some nouns which can be the subject of *depend* but which less obviously describe a scale:

(i) The meaning of a sentence depends on its syntactic structure.
(ii) The solution to the problem depends on which theory of question interpretation is correct.
(iii) The personality of a child depends on how much television he or she watches each day.

The last of these causes a particular headache, in that the DP *the personality of your child* (or *Kim's personality*) should function as an actual CQ. Yet *#Tell me the personality of your child* is no good; and yet again, *Sandy was*

5.3.3. Toward a semantic solution for *ask*

With *ask*, working a pragmatic restriction into the meaning is somewhat more difficult. While *depend* has by its nature a pragmatically determined variable available for modification, no such variable seems to relate the asker to the asked question. This variable, if it existed, would need to find a type $\langle e, et\rangle$ meaning, as it is this type (and not for instance $\langle e, t\rangle$) that is missing from DPs without relational nouns. Compare this to the restriction on *h* postulated for *depend* in (51), which places a restriction on the meaning of a DP; for *ask*, the hypothetical variable would restrict the DP not to particular meanings, but to particular types.

Introducing a variable with a pragmatic restriction does not seem to be the proper way to make use of the $\langle e, et\rangle$ meaning necessarily present in the noun phrase. In fact, this basic approach—having the pragmatics check the DP's composition because it is opaque to the semantics—constitutes an abuse of the division between pragmatics and semantics. A pragmatic restriction may be a natural way to require the presence (or absence) of a particular meaning, but the need for a particular semantic type should arise within the compositional semantic derivation.

Therefore, I suggest that *ask* takes as its first argument a noun (such as *price* or *governor*) which has a type $\langle e, \langle st, t\rangle\rangle$ denotation—recall that objects of this kind are derived from $\langle e, et\rangle$ objects, and thus this type, too, is unique to relational nouns. As its second argument, it takes a noun (*milk*, *Vermont*, etc.) with a type *e* denotation.

(52) $[\![ask]\!]^w = \lambda P_{\langle e, \langle st, t\rangle\rangle} . \lambda y_e . \lambda x_e . [x \text{ asks } P(y) \text{ in } w]$

Because *ask* requires an explicit type-*e* argument, the sentences in (45) will be uninterpretable in spite of having DPs headed by a relational noun. Those RNs have had their argument positions bound with existential closure so that they could be modified by relative clauses with $\langle e, t\rangle$ and $\langle st, t\rangle$ denotations, and therefore lack an $\langle e, \langle st, t\rangle\rangle$ denotation.

The only piece lacking from this meaning is the role of the determiner. For the reasons described above, the determiner is hard to place: if it combines with *price* as an identity function (a strange meaning for the definite determiner in any case), then $[\![the\ price]\!]_{\langle e, \langle st, t\rangle\rangle} + [\![milk]\!]_e$ will give a DP, *the price of milk*, with an $\langle st, t\rangle$ denotation, which as we have seen should be avoided. What meaning it does contribute to this already unconventional derivation remains unclear, and will need further research to uncover. As with the solution to *depend* of the previous section, the meaning of *ask* described here is not the final word on the matter, but it should provide a useful starting point for an explanation of the rather tangled data.

able to predict the personality of her child (while he was still in the womb) is fine, and the DP does have a CQ interpretation.

But whatever factors may be at work here, these nouns are ARNs—the sets of meanings, solutions, and personalities is index-independent in a way that the sets of governors and capitals are not. The notion of "scale" described in the text may need to be refined, either altered to reflect that the function ranges over a clearly delimited set of possibilities, or extended to cover these nouns.

5.4. Summary

When we began exploring the possible meanings of concealed questions, there seemed to be no semantic condition on their distribution. Over the course of the dissertation, we have seen evidence for the PCQC, given in full in (5).

(53) **The Proposition/Concealed Question Correlation**
A concealed question can fill a predicate's argument position if and only if
(a) the Case requirements of the position are met, *and*
(b) a (clausal) question can fill the position, *and*
(c) a (clausal) proposition can fill the position.

This chapter has demonstrated that, not only does (5c) follow from the theory that CQs have propositional meanings, but the apparent stipulation in (5b) can also be made to follow from semantic facts about the presence of a contextual variable common to question meanings and CQ meanings, and that predicates which seem to contradict this correlation have other, independent factors at work.

Consequently, interpreting concealed questions as propositions both derives the correct truth conditions in a compositional manner and allows us to categorize which DPs can be CQs and which predicates can embed them. This constitutes the most complete theory of CQ meanings yet proposed.

CHAPTER 6: CONCLUSION

6.1. Where We Are

This dissertation has argued for a new view of concealed questions and the verbs that embed them. The primary conclusion is that concealed questions denote not questions but propositions with an added question element. For predicates, this means that:

- If a predicate does not license propositions, it will be compositionally incompatible with the proposition meaning of a CQ and thus will not license them.
- If a predicate cannot determine the value of the contextual variable *C* present in both clausal questions and CQs, it will be unable to license either: thus, if a predicate does not license questions, it will not license CQs.
- If a predicate licenses both questions and propositions, it will license CQs.
- If a predicate licenses questions but not propositions, it may allow DPs with meanings similar to identity questions, but the range of DPs is not the full range of CQs.

For nouns, the consequences are that:

- There is a shifting operation that turns relational nouns into CQ heads.
- There is a different shifting operation that turns nonrelational nouns into CQs, when modified appropriately.
- Individual concepts, although intensional like CQs and often formed from relational nouns, are independent entities, created differently and with a different distribution.

To achieve these results, we framed the interpretation of questions in Lahiri's theory of Interrogative Raising, but in fact no new syntactic machinery is needed. Semantically, quantifiers need to be treated cross-categorically, so that in addition to an $\langle et, \langle et, t\rangle\rangle$ meaning, they have an $\langle\langle st, t\rangle, \langle\langle st, t\rangle, t\rangle\rangle$ meaning; the definite determiner, similarly, has both an $\langle et, e\rangle$ meaning and an $\langle\langle st, t\rangle, st\rangle$ meaning. In addition, we have the following types of meanings for nouns, of which only the first two are lexical types.

- Relational Nouns — individuals to sets of individuals — $\langle e, et\rangle$
- Common Nouns — sets of individuals — $\langle e, t\rangle$
- Individual Concept Nouns — sets of individual concepts — $\langle se, t\rangle$
- Functional Propositional Nouns — individuals to sets of propositions — $\langle e, \langle st, t\rangle\rangle$
- Propositional Nouns — sets of propositions — $\langle st, t\rangle$

We also have the following operations to derive one kind of noun from another:

- $\langle e, et\rangle \rightarrow \langle e, t\rangle \quad \lambda P_{\langle e, et\rangle} . \quad \lambda w . \lambda x_e . \exists y_e . [P(w)(y)(x) = 1]$
- $\langle e, et\rangle \rightarrow \langle se, t\rangle \quad \lambda P_{\langle e, et\rangle} . \quad \lambda x_{se} . \exists y_e . \forall w . [P(w)(y)(x(w)) = 1]$
- $\langle e, t\rangle \rightarrow \langle se, t\rangle \quad \lambda P_{\langle e, t\rangle} . \quad \lambda x_{se} . \exists y_e . \forall w . [P(w)(x(w)) \wedge R(w)(y)(x(w))]$
- $\langle e, et\rangle \rightarrow \langle e, \langle st, t\rangle\rangle \quad \lambda P_{\langle e, et\rangle} . \quad \lambda y_e . \lambda p_{st} . \quad [\exists x_e . p = \lambda w_1 . P(w_1)(y)(x)]$
- $\langle e, \langle st, t\rangle\rangle \rightarrow \langle st, t\rangle \quad \lambda P_{\langle e, \langle st, t\rangle\rangle} . \quad \lambda p_{st} . \exists y_e . \quad [P(y)(p) = 1]$
- $\langle st, t\rangle \rightarrow \langle st, t\rangle \quad \lambda P_{\langle s, \langle st, t\rangle\rangle} . \quad \lambda p_{st} . \exists y_e . \quad [\exists q_{st} . p = \lambda w_1 . P(w_1)(q)]$

Taken together, this provides us with a complete description of the grammar of concealed questions.

6.2. The Road Ahead

The first question that arises for any new linguistic theory is, "Does this hold across languages?" We might well expect a great deal of variability due to the presence or absence of any given subset of the shifting operations. In fact, some languages reportedly have no CQs at all (for example, Thai). Other languages have no embedded clausal questions, and embed questions via nominalization (such as Nupe (Kawu 1999)[1]). Between the two, any number of possibilities exist, and it will be interesting to see what future research uncovers.

Another question to investigate is the relation of this new theory of CQs to specificational subjects of copular sentences (SSs). Relating the two is the primary goal of Romero (2003), which she accomplishes by giving individual concept meanings to both. Thus, Romero's use of ICs gives (1) the rough meaning "the value in w_0 of the IC *the number of planets* is nine".[2]

(1) The number of planets is nine.

By using ICs for both SSs and CQs, Romero captures the fact that SSs show the same ambiguity as the one Heim observed for CQs. Hence the bracketed DP in (2) can be the subject of (2a), in which case it denotes, for Romero, the IC whose value in w_0 Fred thought was \$1.29; or it can be the subject of (2b), in which case it denotes the intension of the IC, with the sentence asserting that the extension is the IC *the price of milk.*

(2) [The price that Fred thought was \$1.29]...
  a. ...was actually \$1.79.
  b. ...was the price of milk.

A propositional meaning for the DP seems not to work as a specificational subject: certainly (1) cannot be paraphrased *[*That the number of planets is nine*] *is nine*.

On the other hand, some theories of SSs have suggested that the subject denotes a question. For instance, Schlenker (2003) assigns question denotations to SSs while preserving their DP status, with the object being a partially elided clausal answer to the question—roughly,

---

[1] I am grateful to Roger Schwarzschild for bringing this paper to my attention.

[2] Between the time this dissertation was written and the time it was officially filed, the truth of (1) seems to have changed. This rather bothersome fact fortunately does not affect the discussion.

[*What the number of planets is*] *is* [*the number of planets is nine*].[3] Adapting the analysis of this dissertation to an analysis like Schlenker's should be possible: such a treatment could give the sentence in (1) the meaning:

(3) $\iota p_{st} \,.\, [\exists x_e \,.\, p = \lambda w_1 \,.\, \text{number-of}(w_1)(\text{planets})(x)] \;=\; \lambda w_2 \,.\, \text{number-of}(w_2)(\text{planets})(9)$

If it proves possible, reconciling what Romero calls the "question plus deletion" account of specificational sentences with this analysis of CQs will help maintain the correlations Romero finds between the two.

In the end, I hesitate to commit to such an analysis without further consideration. One immediate concern is that, as with ICs but not CQs, a wide range of DPs can be the subject of a specificational sentence: *The large city in Vermont is Burlington.* I hope that further exploration of the topic can lead to a unified account.

Other phenomena may relate to CQs in their requirement of nominal modification. Dayal (1995) discusses the usage of *any* outside negative or modal contexts, which requires its noun to be modified; as with CQs, relative clauses and postnominal adjectives license *any*, while prenominal adjectives do not:

(4) At the party last night...
   a. #John talked to any politician.
   b. John talked to any politician who is powerful. (=Dayal 1995, 33b)

(5) a. John punished any person responsible.
   b. #John punished any responsible person.

The two constructions do not align exactly—because of the particular meanings involved, *any* is not compatible with superlatives (#...*any most powerful politician*). Dayal's approach is very different than the one in this dissertation, but enough similarity exists to suggest the possibility of a relation between the two.

Similarly, Wolter (2005) analyzes instances of demonstrative *that* with an NP denoting a singleton set. Usually singleton sets are incompatible with demonstratives, which pragmatically require non-singleton sets for the speaker to be distinguishing a single member of.[4]

(6) *That Moon
   *That smallest prime number
   *That center of this flower
   *That mother of John Smith

However, when the NP has certain modification, *that* can be used with singleton sets with a meaning that is neither deictic nor anaphoric.

---

[3] Other accounts treat the subject, like the object, as an elided clause instead of a DP. See Schlenker for a more complete discussion, which would be outside the scope of this chapter. Note that Schlenker uses the term "concealed question" frequently, but I believe that (outside of §4.1, in which he draws specific parallels to Heim 1979) he means it in the informal sense of "a DP that has a question denotation" mentioned and set aside in the introduction to this dissertation.

[4] Setting aside emotive readings of these DPs: "Oh, that mother of John Smith! Whatever will she do next?"

(7) That prime number which is smallest (is also even)
That runner in last place (will be given a consolation prize)
That person responsible (will be punished)
Those students writing a term paper (do not need to take the exam)
*Those responsible people (will be rewarded)

When the noun is plural, the interpretation is necessarily maximal: *those students writing a term paper*, when not referring to a particular set of students made salient, must refer to *all* students writing a term paper. (In contrast, *those responsible people*, which has only the deictic or anaphoric meaning, must refer to a subset of the responsible people.) As with the *any* cases that Dayal analyzes, the specifics of the modification are not identical; it seems that any postnominal modification licenses the demonstrative. But again, the two phenomena are similar enough to warrant comparison.

Finally, references to concealed exclamatives have appeared throughout this dissertation, but there has not been space to investigate them properly here. Exclamatives in general seem to have a straightforward distribution: they can appear as complements of, and only of, factive predicates, and this seems to hold true of concealed exclamatives as well. But the investigation of Portner and Zanuttini (2005) suggests that, while the distributional facts may be different from those of concealed questions, the internal composition is strikingly similar.

REFERENCES

Baker, C.L. 1968. *Indirect questions in English.* Doctoral dissertation, University of Illinois.

Beck, Sigrid and Hotze Rullmann. 1999. "A flexible approach to exhaustivity in questions". *National Language Semantics* 7: 249-298.

Beck, Sigrid and Yael Sharvit. 2002. "Pluralities of questions". *Journal of Semantics* 19: 105-157.

Berman, Stephen. 1991. *The semantics of open sentences.* Doctoral dissertation, University of Massachusetts, Amherst.

Bolinger, Dwight. 1967. "Adjectives in English: attribution and predication". *Lingua* 18: 1-34.

Caponigro, Ivano and Daphna Heller. 2003. "The non concealed nature of free relatives: implications for connectivity". Handout, Workshop on Direct Compositionality (Brown University), June 2003.

Chierchia, Gennaro. 1995. "Individual-level predicates as inherent generics." In Gregory N. Carlson and Francis Jeffry Pelletier (eds.), *The Generic Book*, 176-223. Chicago: University of Chicago Press.

Copley, Bridget. 2002. *The semantics of the future.* Doctoral dissertation, MIT. Available from MIT Working Papers in Linguistics.

Cresswell, Max J. 1976. "The semantics of degree". In Barbara Partee (ed.), *Montague Grammar*, 261-292. New York: Academic Press.

Dayal, Veneeta. 1995. "Licensing *any* in non-negative/non-modal contexts". In Mandy Simons and Teresa Galloway (eds.), *SALT V*, 72-93.

Dor, Daniel. 1992. "Towards a semantic account of concealed questions". In Michael Bernstein (ed.), *Proceedings of the Ninth Eastern States Conference on Linguistics (ESCOL)*, 56-67.

Dowty, David R., Robert E. Wall, and Stanley Peters. 1981. *Introduction to Montague semantics.* Dordrecht: Reidel.

Égré, Paul. 2004. *Attitudes propositionelles et paradoxes épistémiques.* Doctoral dissertation, Université Paris I.

Égré, Paul. 2005. "Some data and problems on question-embedding and veridicality". Handout, École Normale Supérieure talk, January 25, 2005. (Version available at http://www.linguist.jussieu.fr/~amsili/papers/ho.egre05.pdf .)

Ginzburg, Jonathan. 1995. "Resolving questions, I & II". *Linguistics and Philosophy* 18: 459-527 and 567-609.

Grimshaw, Jane. 1979. "Complement selection and the lexicon". *Linguistic Inquiry* 10: 279-326.

Grimshaw, Jane. 1981. "Form, function, and the Language Acquisition Device". In C. L. Baker and John J. McCarthy (eds.), *The logical problem of language acquisition*, 165-182.

Hamblin, C.L. 1973. "Questions in Montague English". *Foundations of Language* 10: 41-53.

Heim, Irene. 1979. "Concealed questions". In Rainer Bäuerle, Urs Egli, and Arnim von Stechow (eds.), *Semantics from Different Points of View*, 51-60.

Heim, Irene. 1994. "Interrogative semantics and Karttunen's semantics for *know*". In Ronna Buchalla and Anita Mittwoch (eds.), *IATL 1*, 128-144.

Heim, Irene and Angelika Kratzer. 1998. *Semantics in generative grammar.* Blackwell.

Janssen, Theo M.V. 1984. "Individual concepts are useful". In Fred Landman and Frank Veltman (eds.), *Varieties of formal semantics*, Proceedings of the Fourth Amsterdam Colloquium, September 1982. Foris Publications.

Karttunen, Lauri. 1977. "Syntax and semantics of questions". *Linguistics and Philosophy* 1, 3-44.

Kawu, Ahmadu Ndanusa. 1999. "*Wh*-questions and focus constructions in Nupe." Unpublished ms., Rutgers University.

Lahiri, Utpal. 2000. "Lexical selection and quantificational variability in embedded interrogatives". *Linguistics and Philosophy* 23: 325-389.

Lahiri, Utpal. 2002. *Questions and answers in embedded contexts*. Oxford University Press.

Larson, Richard K. 1999. "Semantics of adjectival modification". Lectures presented at the Dutch National Graduate School (LOT), Amsterdam, The Netherlands.

Lasersohn, Peter. 2005. "The temperature paradox as evidence for a presuppositional analysis of definite descriptions". *Linguistic Inquiry* 36: 127-134.

Link, Godehard. 1979. *Montague-Grammatik. Die logische Grundlagen.* Munich: Fink.

Löbner, Sebastian. *Intensionale Verben und Funktionalbegriffe. Untersuchung zur Syntax und Semantik von 'wechseln' und den vergleichbaren Verben des Deutschen.* Tübingen: Narr.

Löbner, Sebastian. 1981. "Intensional verbs and functional concepts: more on the 'rising temperature' problem." *Linguistic Inquiry* 12: 471-477.

Montague, Richard. 1973. The proper treatment of quantification in ordinary English. In K.J.J. Hintikka, J.M.E. Moravcsik and P. Suppes (eds.), *Approaches to Natural Language*, 221-242. Dordrecht: Reidel.

Partee, Barbara H., and Mats Rooth. 1983. "Generalized conjunction and type ambiguity." In Rainer Bäuerle, Christoph Schwarze and Arnim von Stechow (eds), *Meaning, Use, and Interpretation of Language*. Berlin: de Gruyter.

Pesetsky, David. 1981. Unpublished ms (summarized in Pesetsky 1991).

Pesetsky, David. 1991. *Zero Syntax vol. 2: Infinitives*. Unpublished manuscript available at http://web.mit.edu/afs/athena.mit.edu/org/l/linguistics/www/pesetsky/infins.pdf .

Portner, Paul and Raffaella Zanuttini. 2005. "Nominal Exclamatives in English". In Robert Stainton and Ray Elugardo (eds.), *Ellipsis and Non-Sentential Speech*, Studies in Linguistics and Philosophy series. Dordrecht: Kluwer.

Romero, Maribel. 2003. "The semantics of concealed questions and specificational subjects". Handout, Workshop on Direct Compositionality (Brown University), June 2003.

Romero, Maribel. 2005. "Concealed questions and specificational subjects". *Linguistics and Philosophy* 28.

Schlenker, Philippe. 2003. "Clausal equations (a note on the connectivity problem)". *Natural Language & Linguistic Theory* 21: 157–214.

Schwarzschild, Roger and Karina Wilkinson. 2002. "Quantifiers in comparatives: a semantics of degree based on intervals." *Natural Language Semantics* 10: 1-41.

Wolter, Lynsey. 2005. "Nonuniqueness implications in demonstrative descriptions". Handout, Annual Meeting of the Linguistic Society of America (Oakland, CA), January 2005.