A Pragmatic Perspective on Concealed Questions[*]

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Abstract

This paper argues that the range of interpretations of concealed question (CQs) is much wider than has previously been assumed. It proposes a principled pragmatic account of this range of interpretations. The account deals with definite, indefinite, and quantified CQs in a uniform way. It also explains Greenberg's (1977) observation and some related facts.

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1 Introduction

Concealed questions (CQs) are determiner phrases (DPs) which are naturally paraphrased as questions.

(1) John knows *the capital of Italy*.
$\approx$ John knows what the capital of Italy is.

(2) They revealed *the winner of the contest*.
$\approx$ They revealed who the winner of the contest was.

Concealed questions do not only arise with definite determiner phrases, but also with indefinite and quantified ones.

(3) John knows a doctor who could help you. (Frana 2006)

(4) John knows every phone number. (Heim 1979)

Heim (1979) observed that quantified CQs exhibit an interesting ambiguity. If no particular context is given, the most salient reading of (4) is probably what we will call the *specificational* reading:

(5) John knows that Ann's number is 503, that Bill's number is 431, etc.

But if John's task is to assign to every newly installed phone a number that is not yet taken by any other phone, then he doesn't need to "know every phone number" in the sense of knowing which phone number is whose, but merely in the sense of knowing which numbers are somebody's at all (Heim, 1979, p.60). We call this the *predicational reading*:[1]

(6) John knows of every phone number that it is a phone number.

Apart from the basic definite, indefinite and quantified CQs exemplified in (1)-(4), there are also structurally more involved cases like:

(7) John knows the capital that Fred knows.

Heim (1979) observed that such CQ-containing CQs (CCQs) are ambiguous. In particular, she noted that (7) has the following two readings, which she

[1] In (Roelofsen and Aloni, 2008) we referred to specificational and predicational readings as *pair-list* and *set*-readings, respectively. The intended interpretation of the terms has not changed; we have just come to find *specificational* and *predicational* more appropriate.

referred to as Reading A and Reading B:[2]

(8) Reading A:

There is exactly one country x such that Fred can name x's capital; and John can name x's capital as well.

(9) Reading B:

John knows which country x is such that Fred can name x's capital (although John may be unable to name x's capital himself).

Suppose Fred knows that the capital of Italy is Rome. Then on Reading A, (7) entails that John also knows that the capital of Italy is Rome. On Reading B, (7) lacks this entailment. It only follows that John knows that Fred can name the capital of Italy.

Of course, CCQs may also be indefinite or quantified:

(10) John knows a doctor that Fred knows.

(11) John knows every/most/at least one capital that Fred knows.

Currently, there is no unified account of definite, indefinite, and quantified CQs and CCQs. In the next section, we will give a brief overview of the theoretical options that have been explored in the recent literature, and point out what we think is the most promising direction to take. Subsequently, we will identify the outstanding problems, and propose a new account. Along the way, we will considerably widen the empirical domain. In particular, among other things, we will show that the A and B readings described above are just two among many readings that may arise for CCQs.

2 Recent Approaches

As depicted in figure 1, recent approaches differ along two dimensions:[3] along the vertical dimension, which we call the TYPE dimension, theories differ

[2]For simplicity, we disregard the distinction between what is presupposed and what is asserted in paraphrasing these readings. We will continue to do so throughout the paper.

[3]An important contribution that is missing from the chart is (Harris, 2007). Harris' work certainly belongs in the [+P] column, but it is not entirely clear in which row it belongs. Harris analyzes CQs as functions from individual concepts to identity questions, or, equivalently, as functions from world-pairs to sets of individual concepts. Aloni's (2008) work can be seen as an attempt to simplify Harris' analysis.

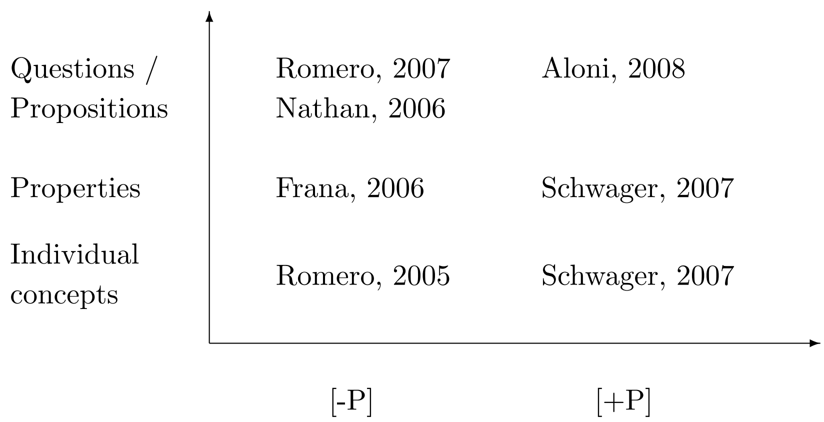

Figure 1: An overview of recent approaches.

in that they assign different semantic *types* to concealed questions. Some take CQs to denote propositions, others take them to denote properties or individual concepts.[4] There are two kinds of arguments along the TYPE dimension. The first involves *coordination*. If concealed questions are not taken to denote propositions it is hard to explain why they can be coordinated with full-fledged declarative and interrogative complement clauses, as in (12) and (13).

(12) They revealed the winner of the contest and that the President of the association would hand out the prize in person.

(13) I only knew the capital of Italy and who won the Worldcup in 1986.

The other argument along the TYPE dimension is one of parsimony. All CQ-embedding verbs also embed full-fledged declarative and/or interrogative clauses. Thus, if CQs are taken to denote propositions, CQ-embedding verbs can be composed with their CQ-complements just as they would be com-

[4] The only approach in the topmost row that explicitly takes CQs to express *questions* is that of Aloni (2008). However, Aloni assumes a partition theory of questions, à la Groenendijk and Stokhof (1984), which means that the extension of a question (whether concealed or not) at each world of evaluation is a proposition (the true exhaustive answer to the question at that world of evaluation). Therefore, Aloni's approach falls into the same category as that of Romero (2007) and Nathan (2006), even though conceptually it is quite distinct.

posed with their full-fledged declarative and/or interrogative complements. If CQs are not taken to denote propositions but, say, properties, then it must be assumed that CQ-embedding verbs are associated with at least two distinct lexical items: one which embeds proposition denoting expressions and one which embeds property denoting expressions. Clearly, such stipulations should be avoided whenever possible. Thus, both arguments along the TYPE dimension favor approaches that take CQs to denote propositions.

Along the horizontal dimension, theories differ in that some take the interpretation of CQs to be dependent on the particular *perspective* that is taken on the individuals in the domain of discourse, while others do not. What this means exactly is best explained by means of an example.

Suppose that in front of you lie two face-down cards. One is the Ace of Hearts, the other is the Ace of Spades, but you don't know which is which. You have to choose one card: if you choose the Ace of Hearts you win 10 euros, if you choose the Ace of Spades you lose 10 euros. Now consider the following sentence:

(14) You know the winning card.

Is this sentence true or false in the given situation? On the one hand, the sentence is true: you know that the Ace of Hearts is the winning card. On the other hand, the sentence is false: as far as you know, the winning card may be the card on the left, but it may just as well be the card on the right. Intuitively, there are two ways in which the cards may be identified in this situation: by their position (the card on the left, the card on the right) or by their suit (the Ace of Hearts, the Ace of Spades). Whether (14) is judged true or false depends on which of these perspectives is adopted. If identification by suit is adopted, the sentence is judged true. But if identification by position is adopted, the sentence is judged false.

Some theories of CQs account for such perspective-related ambiguities, others do not. Clearly, the ones that do are to be preferred.

This leads us to the conclusion that Aloni's (2008) theory, which analyzes CQs as (proposition denoting) questions and accounts for perspective-related ambiguities, is the most promising theory among those proposed in the recent literature. Several problems remain however. In the next section, we discuss Aloni's theory and the problems it faces.

3 Concealed Questions under Cover

Aloni's theory of concealed questions builds on the theory of questions developed in (Aloni, 2001). This is a modification of Groenendijk and Stokhof's analysis, especially geared at capturing the perspective-sensitive nature of questions and other operators in natural language. We will first review Aloni's approach to questions in general. Then we will turn to her account of concealed questions in particular, and point out some of its shortcomings.

3.1 Conceptual Covers

Consider again the card situation discussed in the previous section. In front of you lie two face-down cards. One is the Ace of Spades, the other is the Ace of Hearts. You don't know which is which. There are two different ways of identifying the two cards in this scenario: by their position on the table (the card on the left, the card on the right) and by their suit (the Ace of Spades, the Ace of Hearts). Aloni (2001) proposes to formalize such *methods of identification* in terms of *conceptual covers*. A conceptual cover is a set of individual concepts which exclusively and exhaustively covers the domain of individuals: each individual is identified by exactly one concept in each world. More formally:

Definition 1. [Conceptual covers] Given a set of possible worlds W and a domain of individuals D, a *conceptual cover* CC based on (W, D) is a set of functions $W \to D$ such that:

$$\forall w \in W : \ \forall d \in D : \ \exists! c \in CC : c(w) = d$$

Illustration. To formalize the card situation discussed above we need a model with two worlds, w_1 and w_2, and a domain consisting of two individuals, $\heartsuit$ and $\spadesuit$. As illustrated in the diagram below, either $\heartsuit$ is the card on the left (in w_1) or it is the card on the right (in w_2).

$$\begin{array}{lccc} w_1 & \mapsto & \heartsuit & \spadesuit \\ w_2 & \mapsto & \spadesuit & \heartsuit \end{array}$$

There are only two possible conceptual covers definable over such a model, namely the set A which identifies the cards by their position and the set B which identifies the cards by their suit:

A = {the card on the left, the card on the right}

B = {the Ace of Spades, the Ace of Hearts}

C below is a set of concepts which does *not* constitute a conceptual cover:

C = {the card on the left, the Ace of Hearts}

For C to be a conceptual cover, every individual should instantiate exactly one concept in every world. But this is not the case. In w_1 for example, $\heartsuit$ instantiates two concepts, while $\spadesuit$ does not instantiate any concept at all.

3.2 Quantification under Cover

Aloni (2001) considers a language of first order predicate logic enriched with a ι-operator and a question operator ?. A special index $n \in N$ is added to the variables in the language. These indices range over conceptual covers. A model for this language is a quadruple (W, D, I, C) where W is a set of possible worlds, D a set of individuals, I a world dependent interpretation function and C a set of conceptual covers based on (W, D). A *perspective* $\wp$ is a function from N to C. Sentences are interpreted with respect to assignments under a perspective. An *assignment under a perspective* $g_\wp$ is a function mapping variables x_n to concepts in $\wp(n)$, rather than to individuals in D. Quantification under conceptual cover is defined as follows:

Definition 2. [Quantification under conceptual cover]

$$[\![\exists x_n \phi]\!]_{M,w,g_\wp} = 1 \text{ iff } \exists c \in \wp(n) : [\![\phi]\!]_{M,w,g_\wp[x_n/c]} = 1$$

On this account, variables range over elements of a conceptual cover, rather than over individuals *simpliciter*. The denotation of a variable in a world, however, will always be an individual, and never a concept.

Definition 3. [The denotation of variables] $[\![x_n]\!]_{M,w,g_\wp} = (g_\wp(x_n))(w)$

The denotation $[\![x_n]\!]_{M,w,g_\wp}$ of a variable x_n with respect to a model M, a world w and an assignment under a perspective $g_\wp$ is the individual $(g_\wp(x_n))(w)$, i.e., the value of the concept $g_\wp(x_n)$ in world w. Thus, variables do not refer to concepts, but to individuals. However, they do refer in a non-rigid way: different individuals can be their value in different worlds.

3.3 Questions under Cover

Questions are analyzed in terms of their possible exhaustive answers, as in (Groenendijk and Stokhof, 1984). The evaluation of a question, however, involves quantification over the elements of a conceptual cover rather than over individuals:[5]

Definition 4. [Questions under Conceptual Cover]

$$[\![?x_n.\phi]\!]_{M,w,g_\wp} = \{v \mid \forall c \in \wp(n) : [\![\phi]\!]_{M,w,g_\wp[x_n/c]} = [\![\phi]\!]_{M,v,g_\wp[x_n/c]}\}$$

To express knowledge-*wh*, the language is extended with a knowledge operator K_a selecting questions as complements. A sentence like "a knows-*wh* ϕ" is translated as $K_a(?x_n.\phi)$. A model for the extended language is a quintuple (W, D, Bel, I, C), where W, D, I and C are as above and Bel is a function mapping individual-world pairs (a, w) into subsets of W. Intuitively, $Bel(a, w)$ represents the belief state of a in w. The semantics of the knowledge operator K_a is defined as follows:

Definition 5. [Knowledge-*wh*]

$$[\![K_a(?x_n.\phi)]\!]_{M,w,g_\wp} = 1 \text{ iff } Bel(a, w) \subseteq [\![?x_n.\phi]\!]_{M,w,g_\wp}$$

K_aQ is true in w iff a's belief state is contained in the denotation of Q in w. Since Q's denotation in a world corresponds to Q's true exhaustive answer in that world, K_aQ is true in w iff a believes the true exhaustive answer to Q in w.

Illustration. Consider again the card situation described above. In front of you lie two face-down cards. One is the Ace of Hearts, the other is the Ace of Spades. You don't know which is which. Furthermore, assume that one of the cards is the winning card, but you don't know which. This situation can be modeled as follows (the dot indicates the winning card):

$$\begin{array}{lccc}
w_1 & \mapsto & \heartsuit & \spadesuit^\bullet \\
w_2 & \mapsto & \spadesuit & \heartsuit^\bullet \\
w_3 & \mapsto & \heartsuit^\bullet & \spadesuit \\
w_4 & \mapsto & \spadesuit^\bullet & \heartsuit
\end{array}$$

Consider the following interrogative sentence:

[5]For simplicity, we only define the semantics of single-constituent questions here (like *who called?*). See (Aloni, 2001) for a generalization, which also deals with multi-constituent questions (like *who called whom?*).

(15) a. Which is the winning card?
b. $?x_n.\ x_n = \iota y_n P y_n$

The evaluation of this sentence depends on the perspective that is taken. There are two possible perspectives. Under one ($\wp$), the cards are identified by their position, while under the other ($\wp'$), the cards are identified by their suit:

$$\wp(n) = \{\text{the card on the left, the card on the right}\}$$

$$\wp'(n) = \{\text{the Ace of Spades, the Ace of Hearts}\}$$

The question in (15) partitions the set of worlds in two different ways depending on which perspective is taken:

$$\text{under } \wp: \quad \begin{array}{|c|} \hline w_1 \\ w_2 \\ \hline w_3 \\ w_4 \\ \hline \end{array} \qquad\qquad \text{under } \wp': \quad \begin{array}{|c|} \hline w_1 \\ w_4 \\ \hline w_2 \\ w_3 \\ \hline \end{array}$$

Under $\wp$, (15) disconnects those worlds in which the winning card occupies a different position. Under $\wp'$, it disconnects those worlds in which the winning card is of a different suit. Since different partitions are determined under different perspectives, the fact that different answers are required in different contexts is accounted for. For instance, (16) counts as an answer to (15) only under $\wp'$:

(16) The Ace of Spades is the winning card.

Suppose now you know that the Ace of Spades is the winning card, but you don't know whether it is the card on the left or the one on the right. In this situation your belief state corresponds to the set: $\{w_1, w_4\}$. Sentence (17) is then correctly predicted to be true under $\wp'$, but false under $\wp$.

(17) a. You know which card is the winning card.
b. $K_a(?x_n.\ x_n = \iota y_n P y_n)$

Aloni (2008) applies this analysis of questions and know-*wh* to concealed questions.

3.4 Concealed Questions under Cover

Aloni assumes that the interpretation of concealed questions crucially involves a type-shifting operator $\uparrow_n$ which transforms an entity denoting expression α into the identity question $?x_n.\ x_n = \alpha$ (*which* x_n *is* α*?*), where x_n ranges over some pragmatically determined conceptual cover.

(18) $\uparrow_n \alpha \ =_{\text{def}} \ ?x_n.\ x_n = \alpha$

Illustrations. First consider a 'plain' definite CQ:

(19) a. John knows the capital of Italy.
b. $K_j(\uparrow_n \iota x_m P x_m)$ $\qquad (= K_j(?y_n.\ y_n = \iota x_m P x_m))$

When a question embedding verb like *know* applies to an entity denoting expression like *the capital of Italy*, the type-shift rule $\uparrow_n$ must apply to avoid type mismatch. The resulting sentence is then interpreted according to the analysis of knowing-*wh* given in the previous section.

(20) $[\![K_j(?y_n.\ y_n = \iota x_m P x_m)]\!]_{w,g_\wp} = 1$ iff $Bel(j,w) \subseteq [\![?y_n.\ y_n = \iota x_m P x_m]\!]_{w,g_\wp}$

The intended reading is obtained if n and m are mapped to the following cover representing identification by name:[6]

(21) $n, m \rightarrow$ {Berlin, Rome, Paris, ...}

Under this resolution the embedded question $?y_n.\ y_n = \iota x_m P x_m$ denotes in w the proposition that Rome is the capital of Italy, if Rome is indeed the capital of Italy in w. Sentence (19) then is true in w iff John believes this true proposition in w.

Example (22) illustrates Aloni's analysis of quantified CQs:

(22) a. John knows every European capital.
b. $\forall x_n(P x_n \rightarrow K_j(\uparrow_m x_n))$

The most natural resolution for n and m here is the following:

[6]The notation $n, m \rightarrow$ {Berlin, Rome, Paris, ...} is used to indicate that the variables y_n and x_m are taken to range over the cover $\wp(n) = \wp(m) =${Berlin, Rome, Paris, ...}. Notice that the value $\wp(m)$ assigns to m is not really relevant in this case, because x_m does not occur free in an intensional context.

(23) a. $n \to \{$the capital of Germany, the capital of Italy, $\dots\}$
b. $m \to \{$Berlin, Rome, $\dots\}$

The sentence is then predicted to be true iff for each European country John can name the capital of that country. This captures the specificational reading of the sentence. Note that contrary to the previous example, the quantified case crucially requires a shift in perspective, n and m cannot be assigned the same value here, otherwise the quantified questions would be trivialized.

At last we turn to Heim's CCQ ambiguity. As we mentioned in the introduction, Heim (1979) observed that sentences like (24) have the two readings paraphrased in (25) and (26).

(24) John knows the capital that Fred knows.

(25) Reading A:
There is exactly one country x such that Fred can name x's capital; and John can name x's capital as well.

(26) Reading B:
John knows which country x is such that Fred can name x's capital (although John may be unable to name x's capital himself).

Aloni analyzes Heim's ambiguity as a *de re*/*de dicto* ambiguity:

(27) John knows the capital that Fred knows.
a. $\exists y_n(y_n = \iota x_n(Px_n \wedge K_f(\uparrow_m x_n)) \wedge K_j(\uparrow_m y_n))$ [Reading A]
b. $K_j(\uparrow_n \iota x_n(Px_n \wedge K_f(\uparrow_m x_n)))$ [Reading B]

The intended readings are captured by assuming the following resolution for the indices n and m:

(28) a. $n \to \{$the capital of Germany, the capital of Italy, $\dots\}$
b. $m \to \{$Berlin, Rome, $\dots\}$

On this resolution, Reading A says that there is a unique capital which Fred can identify by name, and that John can identify that capital by name as well. On Reading B, John can identify 'the capital that Fred knows' with one of the individual concepts in the conceptual cover associated with n. That is, there is some country x such that 'the capital that Fred knows' and 'the capital of x' denote the same city in all of John's belief worlds.[7]

3.5 Problems

With respect to the data discussed in the introduction, Aloni's theory faces two problems. The first involves quantified CQs such as (29):

(29) John knows every phone number.

As we noted above, quantified CQs are ambiguous between a specificational reading:

(30) John knows that Ann's number is 503, that Bill's number is 431, etc.

and a predicational reading:

(31) John knows of every phone number that it is a phone number.

As shown in section 3.4, Aloni's theory accounts for the specificational reading. But it has no way of accounting for the predicational reading.

The second problem concerns the A/B ambiguity of quantified CCQs:

(32) John knows every capital that Fred knows.

Recall that Aloni analyzes the A/B ambiguity of definite CQs such as:

[7] Aloni's analysis is illustrated here with the factive question-embedding verb *know*. It carries over straightforwardly to non-factive question-embedding verbs like *ask* and *agree on*, be it that these verbs operate on the *intension* (rather than the extension) of their argument (as in Groenendijk and Stokhof, 1984). A potential problem for the approach, which we do not address here, arises with the verb *wonder*. This verb happily embeds full-fledged questions, as in (i), but is much less receptive to concealed questions. Some attested examples are given in (ii), but these seem marginal and exceptional. This is, in principle, left unexplained by a theory that assimilates CQs with questions.

(i) a. John wonders what the capital of Italy is.
b. John wonders whether Rome is a capital.

(ii) a. Without Michele driving, I'm wondering the best way to get up there. [Lance Nathan, p.c.]
b. Have you ever wondered the most effective way to teach someone something? [`home.shelby.net`]

(33) John knows the capital that Fred knows.

as a *de re*/*de dicto* ambiguity. On the other hand, her account of quantified CQs assumes a *de re* representation. In particular, quantified CCQs such as (32) must be represented *de re*. But this means that the A/B ambiguity of such CCQs cannot be derived as a *de re*/*de dicto* ambiguity.[8]

Apart from these empirical problems, there is also a more technical problem with Aloni's (2008) proposal, having to do with the fact that, by definition, a conceptual cover is a set of individual concepts such that every concept picks out *exactly one* individual in every world. There are many examples of concealed questions which seem to require quantification over a domain of individual concepts that does not necessarily have this special property. Consider the following example:

(34) John knows the price that Fred knows.

Heim's reading B of (34) says that John knows which price Fred knows (e.g., the price of milk, the price of butter, or the price of bread). This reading involves quantification over the domain of individual concepts {the price of milk, the price of butter, ...}. Now, it is possible, of course, that the price of butter and the price of milk coincide in some world, which would mean that not every individual is picked out by a unique concept in that world. Thus, the required domain of quantification is *not* necessarily a conceptual cover.[9]

Notice that this problem does not arise for our original example, (7), just because it happens to be impossible for two countries to have the same capital city. The problem does arise, however, for analogous examples involving temperatures, scores, colors, dates of birth, etc.

To overcome this problem we will make a distinction between *basic* covers and *derived* covers. Basic covers are conceptual covers that satisfy the original requirement that in every world, every individual instantiates exactly one concept. Given a basic cover C and a function $f_{\langle s\langle e\langle e,t\rangle\rangle\rangle}$, the derived cover based on C and f is defined as follows:

(35) $\{c \mid \exists c' \in C. \forall w.\ f_w(c'(w)) = c(w)\}$

[8] Aloni's theory does provide for an alternative strategy to derive the A/B ambiguity, but only under certain rather unnatural assumptions about the resolution of cover indices (see Roelofsen and Aloni, 2008, for some discussion).

[9] A closely related observation has been made by Schwager (2007a).

For example, {the capital of Italy, the capital of Germany,...} is a derived cover based on {Italy, Germany,...} and the *capital-of* function. We will assume that domains of quantification may be derived covers, as well as basic covers, and that functional nouns like *price* and *capital* make derived covers particularly salient.[10]

4 A Pragmatic Theory of CQs

4.1 Basic Proposal

We take as our point of departure the specificational/predicational ambiguity of quantified CQs. As pointed out above, Aloni's theory does not account for this ambiguity, nor does any other theory of concealed questions proposed so far. What is it that makes this case so challenging? Consider again the standard example:

(36) John knows every phone number.

Let us assume (37) as a representation of the truth-conditional meaning of (36), without yet fixing the exact definition of the type-shift operator $\uparrow$.

(37) $\forall x_n(\textsc{phonenumber}(x_n) \rightarrow K_j(\uparrow x_n))$

Now let us just see how $\uparrow$ *should* be defined to get the facts right. In order to capture the specificational reading, we need:

(38) $\uparrow x_n \ \rightsquigarrow\ ?x_m.\ x_m = x_n$

[10]The purpose of Aloni's original restrictions on conceptual covers was to ensure that they would constitute suitable domains of quantification. The crucial intuition was that a set of concepts constitutes a suitable domain of quantification if and only if in each concrete world, each concept is uniquely identifiable. Aloni implemented this idea by requiring that in each world, each concept must be instantiated by a unique entity, that does not instantiate any other concept in that world. However, this implementation can be weakened without giving up the general underlying idea. Namely, given some intensional function from entities to entities—say, the *price-of* function—we could require that in each world, each concept is uniquely identifiable as representing the price of some unique entity (such that no other concept in the given set represents the price of that entity). Derived covers always satisfy this requirement. So, admitting derived covers as domains of quantification as proposed here is compatible with the general idea behind Aloni's earlier work, and may in fact have advantageous repercussions for other domains of application, such as the interaction between quantification and modality.

with:

- $n \rightarrow$ {Ann's phone number, Bill's phone number, ...}
- $m \rightarrow \{5403, 5431, \ldots\}$

In order to get the predicational reading, we want:

(39) $\uparrow x_n \rightsquigarrow\ ?\textsc{phonenumber}(x_n)$

with:

- $n \rightarrow \{5403, 5431, \ldots\}$

To capture this flexibility, we will assume that $\uparrow$ transforms an entity-denoting expression α into the question $?x_n.P(\alpha)$.

(40) $\uparrow_{(n,P)} \alpha\ =_{\text{def}}\ ?x_n.P(\alpha)$

The type-shift has two pragmatic parameters: x_n ranges over some contextually determined conceptual cover and P is a contextually determined property. We assume that by default P is resolved to the property of being identical to x_n, i.e., to the "identity property" $\lambda y.y = x_n$; or to the property expressed by the CQ noun phrase. In the latter case, the resolution of n becomes irrelevant. Indeed, if x_n does not occur free in α, then $?x_n.P(\alpha)$ is equivalent to $?P(\alpha)$, and we will avoid reference to the indexed variable in such cases. Finally, we assume that x_n by default ranges over a naming cover, a rigid cover (in case the individuals in the relevant domain can be identified by ostension), or a derived cover (in case such a cover is made salient by a functional CQ noun).

Thus, (36) is now analyzed as:

(41) $\forall x_n(\textsc{phonenumber}(x_n) \rightarrow K_j(?x_m.P(x_n)))$

The specificational reading is obtained by resolving n, m, and P as follows:

- $n \rightarrow$ {Ann's phone number, Bill's phone number, ...}
- $m \rightarrow \{5403, 5431, \ldots\}$
- $P \rightarrow \lambda y.y = x_m$

which yields:

(42) $\forall x_n(\textsc{phonenumber}(x_n) \rightarrow K_j(?x_m.x_m = x_n))$

The predicational reading results from the following resolution:

- $n, m \rightarrow \{5403,\ 5431,\ \ldots\}$
- $P \rightarrow$ PHONENUMBER

which yields:

(43) $\forall x_n(\textsc{phonenumber}(x_n) \rightarrow K_j(?\textsc{phonenumber}(x_n)))$

In the first case P is resolved to the "identity property", in the second case to the property expressed by the CQ noun phrase. The resolution of m is only relevant in the first case. Notice that, at least for this example, the proposed account does not overgenerate. The only available covers are the naming cover {5403, 5431,...} and the derived cover {Ann's phone number, Bill's phone number, ...}. The only salient properties are the identity property and PHONENUMBER. As a result, any resolution of n, m and P will yield either the specificational or the predicational reading described above.

4.2 CCQs

Let us now consider the case of CCQs. So far we have assumed that CCQs are two-way ambiguous between the A and B readings that Heim (1979) identified. The theory proposed here, however, predicts that there are several additional readings. And upon closer examination these readings are indeed available.[11] To illustrate this, let us consider the most general and most challenging case: quantified CCQs (the theory deals with definite and indefinite CCQs in an analogous way). Consider our initial example:

(44) John knows every capital that Fred knows.

and its analysis:

(45) $\forall x_m((\textsc{capital}(x_m) \wedge K_f(?x_h.\ P_1(x_m))) \rightarrow K_j(?x_n.\ P_2(x_m)))$

[11] In fact, during a recent workshop Heim (2009) herself also pointed out the existence of additional readings for CCQs. In particular, she discussed what we will call below the *predicational* A and B readings (she called them *individual-based* A and B readings). However, we will see that besides the 'original' A and B readings, and the predicational ones, there are even more.

It will be useful to make a distinction between two general types of readings. On the first type of reading, (44) says something about John's knowledge *in contrast/comparison* with Fred's knowledge. On the second type of reading, (44) is concerned with John's knowledge *about* Fred's knowledge. We will refer to readings of the first type as A readings, and to those of the second type as B readings. Notice that on this terminology, the two readings originally described by Heim (1979) are indeed A- and B-type readings, respectively. However, there are several additional A- and B-type readings as well. Let us first consider the A-type readings in more detail.

There are three different A-type readings that quite naturally arise. First, consider a context where John and Fred are given a list of cities, and are asked which of these cities are capitals. In this context, (44) can be taken to mean that for every city x such that Fred knows that x is a capital city, John also knows that x is a capital city (a predicational reading).

Second, consider a context where John and Fred are given a list of cities, and are asked to specify the countries that these cities are the capitals of. In this context, (44) can be taken to mean that for every capital x such that Fred can specify the country that x is the capital of, John can also specify the country that x is the capital of (a specificational reading).

Finally, consider a context where John and Fred are given a list of countries, and are asked to specify the capitals of these countries. In this context, (44) can be taken to mean that for every country y such that Fred can specify y's capital, John can also specify y's capital (another specificational reading).

These readings correspond to the following resolutions:

<u>Predicational A reading</u>:

- $m, h, n \rightarrow \{$Rome, Berlin, Paris, $\dots\}$
- $P_1, P_2 \rightarrow$ CAPITAL

<u>First specificational A reading</u>: [capitals given, countries asked]

- $m \rightarrow \{$Rome, Berlin, Paris, $\dots\}$
- $h, n \rightarrow \{$the capital of Italy, the capital of Germany, $\dots\}$
- $P_1 \rightarrow \lambda y.\ y = x_h$ & $P_2 \rightarrow \lambda y.\ y = x_n$

Second specificational A reading: [countries given, capitals asked]

- $m \to \{$the capital of Italy, the capital of Germany, $\ldots\}$
- $h, n \to \{$Rome, Berlin, Paris, $\ldots\}$
- $P_1 \to \lambda y.\ y = x_h$ & $P_2 \to \lambda y.\ y = x_n$

Notice that in each case x_h and x_n range over the same cover and P_1 and P_2 are resolved to the same property, which is as it should be if (44) is interpreted as a contrastive statement (the constraining effect of contrast on resolution is familiar from the literature on ellipsis, cf. Rooth, 1992; Heim, 1997; Fox, 1999; Roelofsen, 2008).

Now let us consider the B-type readings, which report John's knowledge *about* Fred's knowledge. Again, three distinct readings quite naturally arise.

First, consider a context in which Fred is given a list of cities, and is asked which of these cities are capitals. John, instead, is asked to predict how Fred will respond. In this context, (44) can be taken to mean that for every capital x such that Fred knows that x is a capital, John knows that Fred knows that x is a capital (a predicational reading).

Second, consider a context in which Fred is given a list of capitals, and is asked to specify which countries these are the capitals of. Again, John is asked to predict how Fred will respond. In this context, (44) can be taken to mean that for every capital x such that Fred can specify the country that x is the capital of, John knows that x is a capital such that Fred can specify the country that x is the capital of. We will call this a 'mixed' reading because it reports that John has 'predicational knowledge' about a range of concepts that are characterized in terms of Fred's 'specificational knowledge'.

Finally, consider a context in which Fred is given a list of countries, and is asked to specify the capitals of these countries. Again, John is asked to predict how Fred will respond. In this context, (44) can be taken to mean that for every country y such that Fred can specify y's capital, John knows that y is a country such that Fred can specify its capital (another mixed reading). These readings correspond to the following resolutions:

Predicational B reading:

- $m, n, h \to \{\text{Rome, Berlin, Paris, } \ldots\}$
- $P_1 \to \textsc{capital}$
- $P_2 \to \lambda x_m.\textsc{capital}(x_m) \wedge K_f(?x_h.\ P_1(x_m))$

First mixed B reading: [capitals given, countries asked]

- $m, n \to \{\text{Rome, Berlin, Paris, } \ldots\}$
- $h \to \{\text{the capital of Italy, the capital of France, } \ldots\}$
- $P_1 \to \lambda y.\ y = x_h$ (specificational)
- $P_2 \to \lambda x_m.\textsc{capital}(x_m) \wedge K_f(?x_h.\ P_1(x_m))$ (predicational)

Second mixed B reading: [countries given, capitals asked]

- $m \to \{\text{the capital of Italy, the capital of France, } \ldots\}$
- $h, n \to \{\text{Rome, Berlin, Paris, } \ldots\}$
- $P_1 \to \lambda y.\ y = x_h$ (specificational)
- $P_2 \to \lambda x_m.\textsc{capital}(x_m) \wedge K_f(?x_h.\ P_1(x_m))$ (predicational)

There are two things to notice here. First, the fact that mixed readings arise in this case is no surprise. As alluded to above, the reason why there aren't any mixed A readings is due to the fact that A readings are *contrastive* in nature. B readings are not contrastive, so mixed readings are in principle just as likely to arise here as purely specificational and purely predicational readings.

Second, notice that all the described B readings involve resolution of P_2 to the property $\lambda x_m.\textsc{capital}(x_m) \wedge K_f(?x_h.\ P_1(x_m))$. This is not accidental: it reflects the fact that these readings all concern John's knowledge *about* Fred's knowledge. This also explains why we do not get even *more* B readings: once the resolution of P_2 is fixed, the only freedom that remains is in resolving P_1 and the cover indices. If P_1 is resolved to CAPITAL, then any default resolution of the cover indices either yields the predicational B reading described above ($m \to$ naming), or a trivial meaning ($m \to$ capitals). If P_1 is resolved to the identity property, then any default resolution of the cover indices either yields one of the mixed B readings described above, or again a trivial meaning. Assuming that trivial meanings are generally avoided, it is predicted that, as long as we confine ourselves to default resolutions, the three B readings described above are the only ones that may arise.

Thus, the complete range of CCQ readings is accounted for in a straightforward and perspicuous way, and as long as we stick to default resolutions the proposed theory does not seem to overgenerate.

4.3 Further widening the empirical domain

Now let us turn to some further challenging cases. In particular, we will consider what is known as "Greenberg's observation", and several related facts. Some of these cases will speak in favor of the proposed pragmatic account, but others will reveal a potential problem of overgeneration. This will lead us to a more in-depth analysis of the constraints that play a role in the pragmatic resolution process.

Greenberg's observation. Heim (1979) reports the following minimal pair from (Greenberg, 1977):

(46) John found out the murderer of Smith.

(47) John found out who the murderer of Smith was.

Sentence (46) contains a concealed question, whereas (47) contains an explicit question. Greenberg observed that there is a subtle difference in meaning between the two: (46) necessarily entails that John found out of the murderer of Smith *that he murdered Smith* (direct reading); (47) does not necessarily have this entailment—it may be used to report, for example, that John found out that his gardener was a much sought-after criminal known as "The Strangler" even if John did not find out that the guy actually murdered Smith (indirect reading). This observation is considered to be an important argument against equating concealed questions with their explicit counterparts, or more generally, against analyzing CQs as questions (cf. Heim, 1979; Frana, 2006). However, given the right context, many exceptions to Greenberg's observation can be found.

First exception: the guy with the broken hip. Consider the following situation. There are ten men in a room, three of them are murderers. John has to find out which of the men are murderers.

(48) So far, John only found out the guy with the broken hip.

On its most natural reading, this sentence says that John found out of the guy with the broken hip that he was one of the murderers. Crucially, on this reading, (48) does not entail that John found out of the guy with the broken hip that he had a broken hip.

Second exception: Arequipa. Tomas is confronted with the following list of South American cities:

(49) Caracas, Montevideo, Lima, Porto Alegre, Quito, Arequipa.

He is challenged to say which of these cities are capitals and which are not. His wife Tereza reports:

(50) He only knew the city we visited on our honeymoon last year.

On its most natural reading, this sentence conveys that Tomas only knew of the city that he and Tereza visited on their honeymoon last year, say Arequipa, whether or not it was a capital city. Crucially, Tereza does not report that Tomas only knew that Arequipa was the city that they visited on their honeymoon last year.[12]

Third exception: the Obama's. Michelle Obama says to her daughters, Malia Ann and Sasha:

(51) Today I went to visit a primary school in the neighborhood. At some point one of the children—I think his name was Billy—was asked to name the presidents of all North American countries. But, poor kid, <u>he only knew your father</u>.

On its most natural reading, the underlined sentence says that Billy only knew that Barack Obama was the president of the United States. Crucially

[12]This example also shows that $P(\alpha)$ should be within the scope of the question operator (*contra* Heim (1979) and Frana (2006)): Tereza reports that Tomas knew *whether* the city they visited on their honeymoon was a capital, not necessarily *that* it was a capital.

it does not entail that he knew that Barack Obama was Malia Ann's and Sasha's father.

Last exception. We have already seen another phenomenon which is in conflict with Greenberg's observation: A-type readings of CCQs. Consider our initial example of a definite CCQ:

(52) John knows the capital that Fred knows.

Taking Greenberg's observation at face value, we should expect that the sentence entails that John knows of the capital that Fred knows that it is the capital that Fred knows. But we have already seen that this is not necessarily so. A-type readings of (52) say that John and Fred know the same capital, but do not necessarily entail that John knows anything about Fred.

These 'exceptions' are hard, if not impossible, to explain on a *structural* account of Greenberg's contrast (e.g., Frana, 2006). The pragmatic theory proposed here is flexible enough to deal with them. However, pragmatic accounts always run the risk of overgeneration. Greenberg's original observation, as well as the following example—due to Maribel Romero—clearly show that the pragmatic resolution process must be carefully constrained.

Romero's observation. Lucia just learned her first capital in Kindergarten: she learned that the capital of France is Paris. When her mother picks her up and hears the news from the care-takers, she decides to play a guessing game on her husband Ben in the evening: he will have to find out which capital Lucia learned that day. But incidentally Ben talks to one of the Kindergarten care-takers on the phone later that day and also hears the news. This means that Lucia's mother won't be able to play her guessing game anymore, because:

(53) a. Ben (already) knows the capital that Lucia knows.
b. #Lucia knows the capital that Ben (already) knows.

Sentence (53b) does not convey the intended message in this situation. On our account, however, it is represented as in (54), and it is not hard to find a possible resolution such that (54) indeed entails that 'Ben already knows the capital that Lucia knows'.

(54) $\exists x_m(x_m = \iota y_m[C(y_m) \wedge K_b(?x_h.P_1(y_m))] \wedge K_l(?x_n.P_2(x_m)))$

Problematic resolution:

- $m \to$ capitals & $h, n \to$ naming
- $P_1 \to$ BEING-THE-CAPITAL-THAT-LUCIA-KNOWS & $P_2 \to$ identity

So, on the one hand, we need the flexibility of the pragmatic account to deal with the 'exceptional' cases mentioned above, but on the other hand, the resolution process needs to be suitably constrained. The following section discusses some factors that we take to play a crucial role in this process.

4.4 Constraints on resolution

On the proposed account, the interpretation of a concealed question involves a type shift $\uparrow_{(n,P)}$, where n and P are contextually resolved. As mentioned earlier, we assume that there are certain default choices for n and P. In particular, we assume that P is by default resolved to the identity property or to the property expressed by the CQ noun phrase, and that cover indices are by default resolved to the naming cover, to the rigid cover (if the individuals in the relevant domain can be identified by ostension), or to a derived cover (if such a cover is made salient by a functional CQ noun). But when exactly does an interpreter deviate from these default choices for P and n?

Our proposal is that deviation from the default properties/covers is possible, but costly, and only justified if it is needed in order to comply with Gricean principles of conversation. More precisely, following Aloni (2001), we assume that resolution to a non-default salient property/cover is licensed only if it is needed in order to avoid trivial, contradictory or irrelevant meanings, and only if the obtained interpretation could not have been expressed by a more perspicuous/effective form. In sum:

Default resolutions for P and n:

- P is by default resolved to:
  - the identity property;
  - the property expressed by the CQ noun phrase.

- A cover index n is by default resolved to:
  - the naming cover;
  - the rigid cover (if the individuals in the relevant domain can be identified by ostension);
  - a derived cover (if made salient by a functional CQ noun).

Deviation from default resolutions is licensed:

- only if necessary to avoid trivial/contradictory/irrelevant meanings

  [*quality, quantity, relevance*]

- and only if the meaning obtained by shifting to a non-default resolution could not have been expressed by a more perspicuous/effective form.

  [*manner* as **blocking**]

Below we will illustrate how these principles account for Greenberg's and Romero's observations, as well as the other cases discussed in section 4.3.

Greenberg. Greenberg's CQ example, repeated in (55), has two possible representations, given in (55a) and (55b):

(55) John found out the murderer of Smith.

a. $F_j(\uparrow_{(n,P)} \iota x.\text{MURDERER-OF-SMITH}(x)))$

b. $\exists y_m(y_m = \iota x.\text{MURDERER-OF-SMITH}(x) \wedge F_j(\uparrow_{(n,P)} y_m)$

In a neutral context, the only possible values for m, n and P are the following:

(56) a. *Covers:* naming

b. *Properties:* identity, MURDERER-OF-SMITH

Consider first the *de dicto* representation in (55a). In a neutral context, the predicted resolution for P is the identity property—the other salient property, MURDERER-OF-SMITH, yields a trivial meaning. The only possible resolution of n is the naming cover—there are no other salient covers. This gives us a 'direct reading' of (55), which entails that John found out of Smith's murderer that he murdered Smith.

Now consider the *de re* representation in (55b). In this case, the predicted resolution for P is the property MURDERER-OF-SMITH rather than the identity property, which would yield a trivial meaning. The cover index m must be resolved to naming, the only salient identification method. This, again, gives us a direct reading of (55), entailing that John found out of Smith's murderer that he murdered Smith.

Hence, in a neutral context the resolution process is constrained in such a way that (55) can only be assigned a direct reading, in agreement with Greenberg's observation.

The guy with the broken hip. Now consider the first exception to Greenberg's observation, and its possible representations:

(57) John (only) found out the guy with the broken hip.

a. $F_j(\uparrow_{(n,P)}\ \iota x.\text{GUY-WITH-BROKEN-HIP}(x)))$

b. $\exists y_m(y_m = \iota x.\text{GUY-WITH-BROKEN-HIP}(x) \wedge F_j(\uparrow_{(n,P)}\ y_m)$

In the described context John has to find out which of the men in a room are murderers. It is natural to assume that the following covers and properties are available in this context. We underline the values that would involve non-default resolution, in this case the property MURDERER.

(58) a. *Covers:* naming, rigid

b. *Properties:* identity, GUY-WITH-BROKEN-HIP, <u>MURDERER</u>

No matter whether we assume the *de re* or the *de dicto* representation of (57), the only resolution of P that yields a relevant meaning in this context is the non-default resolution to the property MURDERER. Given this resolution the sentence could be interpreted as: 'John found out whether the guy with the broken hip was a murderer' (*de dicto*), or 'of the guy with the broken hip, John found out whether he was a murderer' (*de re*). Before accepting a non-default resolution, however, we have to check whether there is a more perspicuous way to express the obtained meanings in the given context. This is not the case here. Therefore, the non-default resolution is licensed.[13]

[13]Intuitively, adding *only* to example (57) makes it easier to establish a non-default resolution. This may be explained by the fact that, if *only* is added, default resolution of P to GUY-WITH-BROKEN-HIP yields the following meaning: 'only of the guy with a broken hip, John found out that he had a broken hip'. This is not merely an irrelevant meaning, but moreover a meaning to which *only* does not make any essential contribution. For, if

Summary of predicted resolutions:

- For (57a): $P \rightarrow$ <u>MURDERER</u> [others trivial or irrelevant]

  'John found out whether the guy with the broken hip was a murderer'

- For (57b):
  $P \rightarrow$ <u>MURDERER</u>
  $m \rightarrow$ naming/rigid cover [others trivial or irrelevant]

  'Of the guy with the broken hip, John found out whether he was a murderer'

- Blocking check: Is there another more effective way to express these meanings in the given context? No.

The Arequipa example is dealt with in exactly the same way.

The Obama's. Consider the relevant sentence and its possible analyses:

(59) Billy (only) knew your father.

a. $K_j(\uparrow_{(n,P)}\ \iota x.\text{YOUR-FATHER}(x))$

b. $\exists x_m(x_m = \iota x.\text{YOUR-FATHER}(x) \wedge K_j(\uparrow_{(n,P)}\ x_m))$

In the described context there are two salient covers, the naming cover and the derived 'presidents cover': {the president of the United States, the president of Canada, the president of Mexico, ...}. Resolution to the latter cover would be exceptional, for the functional noun 'president' is not contained in the CQ. The available options for P on the other hand, are the identity property and the property expressed by the CQ noun phrase.

(60) a. *Covers:* naming, <u>presidents</u>

b. *Properties:* identity, YOUR-FATHER

Assuming the *de dicto* representation, (59a), any possible resolution yields a trivial meaning ($P \rightarrow$ YOUR-FATHER) or an irrelevant meaning ($P \rightarrow$ ID). As for the *de re* representation, the only resolution that provides a relevant meaning is the one that maps P to the identity property, n to the naming cover, and m to the derived presidents cover. This is a non-default resolution,

there is only one guy with a broken hip, of whom else could John have found out that he had a broken hip?

so we need to check for the availability of a strictly more efficient way to express the obtained meaning in the given context. A natural candidate is the sentence 'Billy only knew the president of the US' which would convey the same meaning without the need for non-default resolution. However, for independent reasons, it is strongly dispreferred for Michelle Obama to refer to her husband as 'the president of the US' when talking to her daughters. 'Your father' is the preferred referential expression in this context (cf. Gundel *et al.*, 1993; Aloni, 2001). Therefore, the non-default resolution is licensed in this case.

Summary of predicted resolutions:

- For (59a): either trivial [$P \to$ YOUR-FATHER] or irrelevant [$P \to$ ID]

- For (59b):
  $P \to$ identity
  $n \to$ naming
  $m \to$ presidents [others trivial or irrelevant]

  'Billy (only) knew who the president of the US was'

- Blocking check: Is there another more perspicuous way to express this meaning in the given context? No.
  (Referring to Obama as 'the president of the US' when talking to Obama's daughters is dispreferred for independent reasons.)

Notice that this example differs from the broken hip example and the Arequipa example in that it involves non-default *cover selection* rather than non-default resolution of P.

Finally, we turn to Romero's example, which is a case where non-default resolution is *blocked* by an alternative, more efficient form.

Romero. Consider Romero's example and its two possible representations:

(61) Lucia knows the capital that Ben (already) knows.

a. $K_l(\uparrow_{(m,P_1)} \iota y_m[C(y_m) \wedge K_b(\uparrow_{(n,P_2)} y_m)])$

b. $\exists x_m(x_m = \iota y_m[C(y_m) \wedge K_b(\uparrow_{(h,P_1)} y_m)] \wedge K_l(\uparrow_{(n,P_2)} x_m))$

The available covers and properties in the given context are:

(62) a. *Covers:* naming, capitals

b. *Properties:* identity, CAPITAL-B-KNOWS, CAPITAL-L-KNOWS

As in the previous example, the *de dicto* representation does not yield any relevant interpretation. As for the *de re* representation, the only resolution leading to a relevant meaning is the resolution mapping m to the derived capital cover, n to the naming cover, P_1 to CAPITAL-LUCIA-KNOWS and P_2 to the identity property. Given this resolution, the sentence conveys that Ben already knows the capital that Lucia knows. However, this interpretation involves non-default resolution, so we need to check whether it is blocked. And in this case there is indeed a much more perspicuous way to express the relevant meaning, namely the sentence: 'Ben already knows the capital that Lucia knows'. Therefore, the non-default resolution is discarded and the interpretation procedure fails to derive a relevant meaning.

Summary of predicted resolutions:

- For (61a): all either trivial or irrelevant
- For (61b):
  $P_1 \rightarrow$ CAPITAL-THAT-LUCIA-KNOWS
  $P_2 \rightarrow$ identity
  $m \rightarrow$ capitals
  $n \rightarrow$ naming [others trivial or irrelevant]

  'Ben (already) knows the capital that Lucia knows'
- Blocking check: Is there another more effective way to express this meaning in the given context? **Yes.**
  $\Rightarrow$ the interpretation process fails to derive a relevant meaning

Thus, the proposed constraints on resolution, which were motivated by commonplace ideas from Gricean pragmatics, account for Greenberg's and Romero's observations, while preserving enough flexibility to deal with the broken hip example, the Arequipa example, and the Obama case.

5 Conclusion

We have proposed a pragmatic theory of concealed questions whose central assumption is that an entity-denoting expression α may be type-shifted into a question $?x_n.P(\alpha)$, where P is a contextually determined property, and x_n

ranges over a contextually determined conceptual cover. Thus, depending on the resolution of P and n, a concealed question is either interpreted as the identity question *which* x_n *is* α, or as the polar question *whether* α *has the property* P. Aloni's (2008) account, like many other accounts in the literature, focused on the first kind of interpretation. We hope to have shown that both kinds of interpretation arise systematically, and that any theory of concealed questions should take this observation as a point of departure.

Finally, let us remark that the account presented here is related to the theory of anaphora proposed by Roelofsen (2008). One of the basic claims of that theory is that the interpretation of NP and VP anaphora, just like that of concealed questions, crucially involves the contextual resolution of a property P. Moreover, P is by default resolved to the property expressed by some overt NP or VP in the surrounding discourse, or to the property of being identical to some bound variable. This is in exact analogy with the default resolution of P in the interpretation of concealed questions.

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