Topic Abstraction as the Source for Nested Alternatives: A Conservative Semantics for Contrastive Topic

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1. Introduction

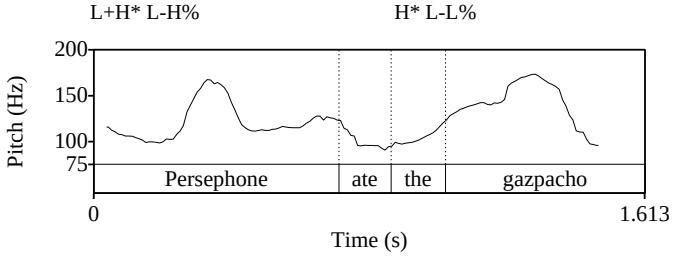
In this paper, I argue for a new semantics for contrastive topic (CT) constructions that relies on a TOPIC ABSTRACTION operator to generate nested alternative structures. Compared to previous accounts like Büring 2003, my proposal is conservative in that it neither appeals to a new type of F-marking (cf. Büring's CT-marks) nor stipulates any discourse conditions particular to the CT construction (cf. Büring's CT-Congruence). Beyond the advantage of parsimony, the account has several empirical advantages. It extends easily to CT questions and new multiple CT data that are problematic on the standard approach. The account also provides an explanation for the limited island sensitivity of CT, and correctly predicts narrow scope for CT-marked decreasing quantifiers like *few*.

2. Contrastive Topic and Büring's Proposal

Descriptively, contrastive topics occur in utterances that don't completely resolve a particular salient issue. For example, in (1), speaker B resolves the question of what Persephone ate, but does not address the salient question of what Antonio ate. The CT-marked *Persephone* is the topic of the implicit question that B directly answers, namely the question of what Persephone ate, and contrasts with the topic of the unanswered question of what Antonio ate.

I use $[\cdot]_{CT}$ and $[\cdot]_{Exh}$ throughout as informal shorthands to indicate which phrases are contrastive topic and exhaustive focus (intuitively, the answer to the question) respectively. These correspond to the formal CT- and F-marking of Büring's (2003) account. Note that on my final proposal these distinctions will not be coded directly in syntactic features; both types of phrase will formally only be F-marked. Italics in examples indicate stress, and bold will highlight items of interest.

(1) A: What about Persephone and Antonio? What did *they* eat?
B: [*Persephone*]$_{CT}$ … ate [the *gazpacho*]$_{Exh}$. **CT+Exh**



In English, CT is associated with the contour (L+)H* L-H% (Büring 2003), consisting of a rising or high pitch accent (L+H* or H*) and a subsequent low-rising boundary tone (L-H%). Other languages

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mark CT via a discourse particle, as in Japanese CT *wa* (Heycock 2008, Tomioka 2010b) shown in (2), or Mandarin CT *ne* (Constant 2011), or by a dedicated syntactic position, as in Czech (Sturgeon 2006) or Italian (Frascarelli & Hinterhölzl 2007).

(2) A: Who ate what? Tomioka 2010b: 123

B: *Erika*-**wa** *mame*-o tabe-ta (kedo)
Erika-TOP beans-ACC eat-PAST but
'[*Erika*]$_{CT}$ ate [*beans*]$_{Exh}$, but . . . '

The questions of whether the CT and Exh constituents can occur in the opposite order, and whether a CT can occur in the absence of an Exh are controversial. Following Jackendoff (1972) and Büring (2003), I aim for a unified account that covers (i) the standard CT+Exh order seen above, (ii) the reverse Exh+CT order as in (3), and (iii) cases of lone CT or "Rise-Fall-Rise" (Constant, to appear) like (4). The fact that the theory of CT presented here covers these three cases naturally speaks in favor of such a unification. Further motivation for this approach is provided in Constant (in prep.). For a contrary view, see Wagner (2012).

(3) A: What about the gazpacho and the ceviche? Who ate *those*?
B: [*Persephone*]$_{Exh}$ ate [the *gazpacho*]$_{CT}$ . . . **Exh+CT**
H* L-L% L+H* L-H%

(4) A: What about Persephone and Antonio? Did *they* eat the gazpacho?
B: [*Persephone*]$_{CT}$ ate the gazpacho. . . **Lone CT**
L+H* L-H%

On Büring's (2003) theory, CT always marks a response to some question within a larger STRATEGY of questions, in the sense of Roberts (1996). Beyond this, Büring requires that all the questions within the strategy be contained within the "ct-value" of the response. This ct-value is sensitive to CT- and F-marking, which Büring takes to be present in the syntax. Intuitively, the ct-value of an utterance is the set of questions we get by first substituting in the F-marked position(s) to get a single question, and then substituting in the CT-marked position(s) to get a set of questions. Formally, the effect of CT-marking derives from Büring's (2003: 520) CT-Congruence condition in (5), and ct-values are calculated compositionally as in (6).

(5) a. Utterance U containing CT can map onto a move M within a discourse tree D only if U indicates a strategy around M_U in D.

b. U indicates a strategy around M_U in D iff there is a non-singleton set Q′ of questions such that for each $Q \in Q'$, (i) Q is identical to or a sister of the question that immediately dominates M_U, and (ii) $[\![Q]\!]^o \in [\![U]\!]^{ct}$

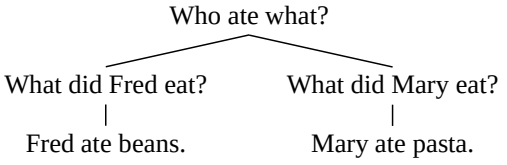
(6) $[\![A]\!]^{ct}$ = Büring 2003: 539

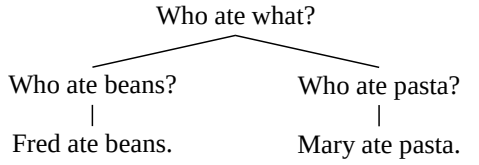
a. if A is F-marked, $\{ D_{type(A)} \}$
b. otherwise, if A is CT-marked, $\{ \{\alpha\} \mid \alpha \in D_{type(A)} \}$
c. otherwise, if A is a terminal, $\{\{ [\![A]\!]^o \}\}$
d. otherwise, if A = [B], $[\![B]\!]^{ct}$
e. otherwise, if A = [B C], $\{\beta \mid \exists b,c [b \in [\![B]\!]^{ct} \ \& \ c \in [\![C]\!]^{ct} \ \& \ \beta = \{\alpha \mid \exists b',c' [b' \in b \ \& \ c' \in c \ \& \ \alpha = b' + c']\}]\}$

The ct-values in (7) and (8) illustrate how Büring's theory works on simple CT+Exh and Exh+CT sentences from Jackendoff (1972: 261). Note that switching which elements are CT and Exh results in a different ct-value, and thus implies a discourse strategy of a different shape. The discourse trees below show examples of discourses that would be congruent with the two utterances.

(7) $[\![\text{[Fred]}_{\text{CT}} \text{ ate [the beans]}_{\text{F}}]\!]^{ct}$
$= \{ \{x \text{ ate } y \mid y \in D_e\} \mid x \in D_e \}$
$= \left\{ \begin{array}{c} \{\text{Fred ate beans, Fred ate pasta, } \ldots\}, \\ \{\text{Mary ate beans, Mary ate pasta, } \ldots\}, \\ \ldots \end{array} \right\}$
= 'For each person, what did they eat?'

(8) $[\![\text{[Fred]}_{\text{F}} \text{ ate [the beans]}_{\text{CT}}]\!]^{ct}$
$= \{ \{x \text{ ate } y \mid x \in D_e\} \mid y \in D_e \}$
$= \left\{ \begin{array}{c} \{\text{Fred ate beans, Mary ate beans, } \ldots\}, \\ \{\text{Fred ate pasta, Mary ate pasta, } \ldots\}, \\ \ldots \end{array} \right\}$
= 'For each food, who ate it?'





There are deep parallels between Büring's proposal for CT and Rooth's (1996) proposal for focus. Rooth posits F-marks in the syntax, and adds a new dimension of composition, so that every expression has not only an ordinary semantic value $[\![\cdot]\!]^o$ but also a focus semantic value $[\![\cdot]\!]^f$. These f-values provide a single level of abstraction. If the ordinary value of a sentence is a proposition, then its f-value will necessarily be a *set* of propositions—a question. Büring takes us one step further. CT-marks are posited in the syntax, and expressions now have three semantic values. If the f-value is a set of propositions, the ct-value will be a set of *sets* of propositions—or a set of questions. However we'll see in the next section that this use of ct-values runs into various problems. On the one hand, the extra layer of abstraction predicts the absence of CT-marking in questions. On the other hand, we'll see that one extra layer is not enough; multiple CT data indicate the need for arbitrarily nested alternatives sets.

3. Empirical Problems

3.1. CT Questions

What are the predictions of Büring's (2003) system as to the well-formedness and meaning of CT marking in questions? For example, what would the ct-value of a question like (9) be, and what kinds of discourses would it be congruent with?

(9) What did [Fred]$_{\text{CT}}$ eat?

One approach, following Büring 2003 literally, is to stipulate that questions have no ct-values, leading to the prediction that CT-marking will impossible in questions. Since English and German fail to realize the overt CT contours in questions[1] (Büring 2003: 519 ff. 7), this initially seems like a plausible line of attack. However as soon as we turn to overtly CT-marked questions in Japanese (10), Mandarin (11), Czech (Sturgeon 2006: 49) and Turkish (Kamali & Büring 2011: 6), it becomes clear that the general theory of CT cannot be ruling such questions out in principle. In each case, the speaker implies a strategy of contrasting questions that differ in the CT-marked position.[2]

(10) … Zyaa *Erika*-**wa** doko-e itta-no? Tomioka 2010a: 123
then Erika-TOP where went-Q
'…, well then, where did [*Erika*]$_{\text{CT}}$ go?'

(11) Nà nǐ xiǎng-bù-xiǎng chī *shuǐ-zhǔ-yú* **ne**? Constant 2011: 20
then you want-not-want eat water-boil-fish CT
'(If you don't want to have hotpot…) then do you want to have [*boiled fish*]$_{\text{CT}}$?'

[1] This is not quite right, for English at least. The CT contour arises in questions that are phrased in two separate intonational phrases, as in "(I know what Mary gave to John…) But what did *Fred* … give to *Sue*?" This suggests that the problem with CT intonation in simple questions may be phonological in nature.

[2] These CT questions are a puzzle for Wagner's (2012) analysis of CT, since they appear to contain a CT in the absence of any Exh. For Wagner, CT-marking always reflects a CT+Exh structure.

In fact, there is nothing preventing us from calculating the ct-value of a question. However we run into a number of problems when plugging the resulting ct-value into the definition of CT-Congruence from (5) above. First of all, as it stands, the congruence condition would require *not* that the CT-marked question itself contrast with other questions, but that some larger and possibly implicit dominating question does. Thus, the first step towards incorporating these data under Büring's model would be to modify CT-Congruence along the lines of Kamali & Büring (2011), where changes are in bold:

(12) U indicates a strategy around M_U in D iff there is a non-singleton set Q' of questions such that for each $Q \in Q'$, (i) Q is identical to or a sister of **either question M_U or** the question that immediately dominates **assertion** M_U, and (ii) $[\![Q]\!]^o \in [\![U]\!]^{ct}$

Although it is unsatisfying to have to split the definition into two sub-conditions, this modification could be seen as encoding the real asymmetry that CT-marked statements *answer* sub-questions within a strategy, whereas CT-marked questions *are* sub-questions within a strategy. However there is a larger problem that still remains. Returning to the example "What did $[\text{Fred}]_{CT}$ eat?", what will its ct-value be? To get the congruence condition to make the right predictions, we need the ct-value of the utterance to be the set of questions of the form *What did x eat*—just the same ct-value that we had in (7). More generally, we would like the ct-value of a question to be the same as the ct-value of its answer.

Unfortunately, this equality of ct-values for questions and answers cannot arise on Büring's account. The root of the problem can be found in the definition of ct-value composition in (6). A corollary of this definition, provable via induction, is that the ct-value of any utterance is a set of sets of whatever type the utterance denotes. Thus, once we accept the basic premise that Büring inherits from Hamblin (1973) that a question denotes a set of propositions, we guarantee that the ct-value of a question will be a set of sets of sets of propositions, or a set of sets of questions. So as long as a question and statement denote different types, their ct-values will also be different types.

We can illustrate a particular instantiation of the problem under a simple Hamblin semantics for questions, where the (ordinary) denotation of a wh- word is a set of individuals (e.g. $[\![\text{what}]\!]^o = D_e$). This implementation allows us to compute the ordinary semantic value and the ct-value of the question "What did $[\text{Fred}]_{CT}$ eat?" as in (13). Crucially, the extra level of embedding in (13b) makes this ct-value incompatible with either Büring's original congruence condition, or the modified version we formulated above. Either condition will require that the discourse contain questions whose denotations are members of (13b). But since these members are not question denotations, the condition will be unsatisfiable.

(13) a. $[\![[\text{Fred}]_{CT} \text{ ate what}]\!]^o = \{$ Fred ate the beans, Fred ate the pasta, … $\}$

b. $[\![[\text{Fred}]_{CT} \text{ ate what}]\!]^{ct} = \left\{ \begin{array}{c} \{\{ \text{Fred ate the beans, Fred ate the pasta, } \ldots \}\}, \\ \{\{ \text{Mary ate the beans, Mary ate the pasta, } \ldots \}\}, \\ \ldots \end{array} \right\}$

To summarize then, the account of CT meaning in Büring 2003 is not well-equipped to handle CT marking in questions. The essence of the problem is that ct-values are computed in terms of substitutions to the ordinary semantic value. Since questions already denote sets, their ct-values will contain an unwanted extra level of embedding, and hence be unusable for the purposes of discourse congruence. As we saw, this problem extends to Kamali & Büring's (2011) modified proposal.

3.2. Multiple CT

In this section, I present preliminary data suggesting that the felicity of sentences with multiple CT's in discourse can depend on which CT is structurally higher. These findings run counter to the predictions of Büring 2003, as well as more recent theories including Tomioka 2010b and Wagner 2012. Consider the requests in (14) and the initial responses in (15)—ignoring for a moment the continuations with *but*. The basic observation is that (14a+15a) and (14b+15b) create natural request-response pairs, whereas the reverse pairings (14a+15b) and (14b+15a) are degraded.[3]

[3] This judgment appears to be robust across speakers, but depends on the prosody being rendered explicitly. The essential factor is that there need to be clear breaks with rising boundaries at each point where L-H% is marked.

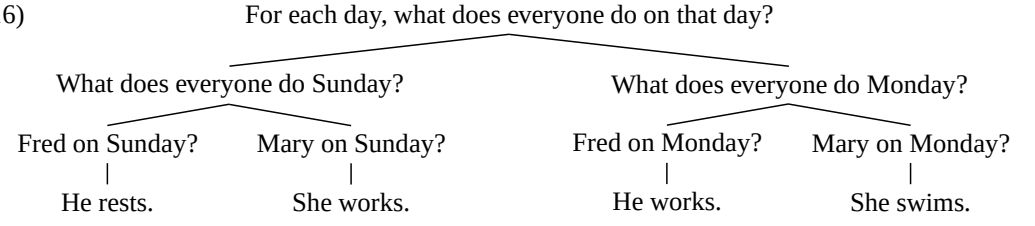
(14) a. For each day of the week, tell me what everyone does on that day.
b. For each person, tell me what they do on each day of the week.

(15) a. On [*Sundays*]$_{CT}$ … [*Fred*]$_{CT}$ … [*rests*]$_{Exh}$.
L+H* L-H% L+H* L-H% H* L-L%
{ But *Mary works* (on Sundays). / ??But on *Mondays*, he *works*. }

b. [*Fred*]$_{CT}$ … on [*Sundays*]$_{CT}$ … he [*rests*]$_{Exh}$.
L+H* L-H% L+H* L-H% H* L-L%
{ But on *Mondays*, he *works*. / ??But *Mary works* (on Sundays). }

These judgments indicate that multiple CT sentences can give rise to richly structured strategies. For example, (15a) implies a broad strategy of questions about different days, each of which is itself a strategy broken into sub-questions about what different people do on that day. A discourse tree proceeding along the lines of such a strategy is given in (16). The continuations in (15) confirm that the two CT's are not treated on a par. Since (15a) implies a sorting of days over people, there is a strong expectation to stick to one day until all people have been exhausted before moving to the next day.

(16)



This nesting of strategies within strategies cannot be modeled using Büring's ct-values, since there is only a binary distinction between CT- and F-marks. The composition rules for ct-values ensure that regardless of syntactic position, all CT-marked phrases end up collapsed to a single level in the discourse structure. Thus, for example, (15a) and (15b) receive the same ct-value, and we fail to account for the asymmetry between the two forms:

(17) $[\![$ on [Sundays]$_{CT}$ [Fred]$_{CT}$ [rests]$_F$ $]\!]^{ct}$ = { {Fred rests Sunday, Fred works Sunday, … }, {Mary rests Friday, Mary works Friday, … }, … }
$[\![$ [Fred]$_{CT}$ on [Sundays]$_{CT}$ [rests]$_F$ $]\!]^{ct}$
= 'For each day/person pair, what does that person do on that day?'

As with CT questions, the problem here is with an inflexibility in how ct-values are composed. No matter how many F- and CT- phrases are present, the ct-value of a declarative will only go two levels deep; it will be a set of sets of propositions—i.e. a set of simple questions. Given the structure of Büring's account, the natural way to add another layer of nesting would be to repeat the process of introducing CT-marks all over again. We would have CT_1 and CT_2 marks in the syntax, and ct_1- and ct_2-values in the semantics. The composition rules for $[\![\cdot]\!]^{ct_2}$ would be hairier than those in place for ct_1, but would get the job done. But all this begs the question of whether there isn't a more general solution that can add successive layers of embedding for each CT. The next section aims for a solution of this kind.

As the licensing of multiple CT has not been explored in the literature to my knowledge, and the judgments are subtle, the empirical facts should be investigated more carefully, and across a range of languages. I leave this to future work, but point out two relevant places to look. First, Yabushita (2008) has documented sentences of Japanese with multiple CT's, as in (18). However, he does not address the discourse licensing of such sentences, and indeed Yabushita's account will not allow one CT to scope above another. It may turn out that examples like (18)—where multiple CT's can be analyzed as all being *in-situ*—are generally ambiguous as to the scopal relation between the CT elements. If so, these sentences will not provide direct evidence for nested strategies.

(18) Jon-**wa** Mearii-**wa** Biru-ni-**wa** shookai-shi-ta. Yabushita 2008: 748
John-CT Mary-CT Bill-to-CT introduction-do-PAST
'[John]$_{CT}$ introduced [Mary]$_{CT}$ to [Bill]$_{CT}$.'

A more promising parallel to the English facts is found in Dholuo, a Nilo-Sarahan language of Kenya and Tanzania. The Dholuo CT particle *to* occurs exclusively marking fronted contrastive topics, and may occur more than once per clause (Constant 2009). In the following example, the surface order of two CT's reflects their relative scope in a discourse that sorts people over veggies—as evidenced by the fact that we stick to a single person across different veggies. However more work needs to be done to test the CT ordering facts on a wider range of examples.

(19) A: Which seller's vegetables do you like the best? Constant 2009

B: Buth Ochieng mit ahinya, to apodhe to ok mit.
pumpkin.POSS Ochieng tasty very but okra.POSS CT not tasty
Awiti **to** odiende **to** a-hero, to omboke to ok a-hero.
Awiti CT cactus.POSS CT 1SG-like but amaranth.POSS CT not 1SG-like
'Ochieng's *pumpkin* is delicious, but his *okra* is not good.
[*Awiti*]$_{\text{CT}}$, [her *cactus*]$_{\text{CT}}$, I like, but her *amaranth* I don't.'

4. The Topic Abstraction Account

The topic abstraction account I present here builds on recent work by Tomioka (2010ab), Davis (2010), and Wagner (2012). For comparisons with these approaches, see Constant (in prep.). My proposal is conservative in the sense of using a minimum of new machinery beyond the classic alternative semantics in Rooth 1996. The basic idea will be to build complex nested alternative structures—those "set of question" meanings that Büring stores in ct-values—directly in the f-value dimension. As a result, ct-values are not needed, and there are no CT-marks in the syntax. Furthermore, no congruence condition or special operator is needed to stipulate how a set of alternatives in a CT utterance is related to the discourse. Following Rooth, the interaction between alternatives and discourse is regulated by the squiggle ($\sim$) operator, which is already in place to deal with question-answer congruence in general. On this view, CT utterances are just sentences that refer anaphorically to a set of questions or discourse strategy—by exactly the same mechanism that an utterance with exhaustive focus like "[Ede]$_{\text{F}}$ wants coffee" refers back to a simple question of who wants coffee.

On Rooth's alternative semantics, as it stands, f-values can never become nested—they never have sets as members. Lexical items all have non-nested sets as their f-values (e.g. $[\![\text{John}]\!]^f = \{\text{John}\}$), and pointwise composition rules guarantee that the f-values of complex constituents remain non-nested. The innovation of the topic abstraction account is the positing of an operator that adds a layer of nesting in the focus dimension, by abstracting over alternative sets as follows:

(20) **Topic Abstraction**

a. $[\![\text{CT}_i\ \alpha]\!]^o_g = \lambda x.[\![\alpha]\!]^o_{g[i\to x]}$ (Ordinary Semantic Value)

b. $[\![\text{CT}_i\ \alpha]\!]^f_g = \{\lambda x.[\![\alpha]\!]^f_{g[i\to x]}\}$ (Focus Semantic Value)

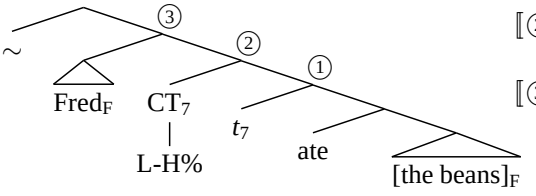
Topic abstraction over a trace t_τ produces in the f-dimension a function from D_τ to alternative sets. This operator was rejected by Novel & Romero (2010: 326) as a candidate for predicate abstraction, for precisely the reason that it generates problematic "higher-order" alternatives.[4] Yet this nesting is just what we need to encode the dependence of an utterance on a contextual strategy of questions.

To build structures interpretable by topic abstraction, we need a syntactic operation that raises a contrastive topic to the CT operator position, leaving a trace below. This is parallel in function to quantifier raising, which leaves a structure interpretable by predicate abstraction. We see direct evidence for movement of this kind in overt topicalization structures like "The beans, Fred ate", where the moved constituent is interpreted as contrastive topic. The novel claim here is just that in-situ CT phrases undergo

[4] The problem for Novel and Romero is that functions to alternative sets can't serve as arguments to generalized quantifiers. For example, in the sentence "Who saw nobody?", the GQ *nobody* can't combine with the function from individuals to sets of propositions $\lambda x.\{y \text{ saw } x \mid y \in \text{D}_e\}$. This sort of type clash with quantifiers still arises on the topic abstraction account, but I argue below that this is a virtue, as the problematic readings are not attested.

covert topicalization (cf. Davis 2010, Wagner 2012). With this in place, the logical form for a CT+Exh structure will be as follows:

(21) "[Fred]$_{CT}$ ate [the beans]$_{Exh}$."



$[\![①]\!]^f_g$ = { $g(7)$ ate the beans, $g(7)$ ate the pasta, … }

$[\![②]\!]^f$ = { $\lambda x.$ { x ate the beans, x ate the pasta, … } }

$$[\![③]\!]^f = \left\{ \begin{array}{c} \{\text{Fred ate beans, Fred ate pasta, } \ldots\}, \\ \{\text{Mary ate beans, Mary ate pasta, } \ldots\}, \\ \ldots \end{array} \right\}$$

= 'For each person, what did they eat?'

One important difference between QR and topic raising is that in the case of topic raising, the abstraction operator is pronounced. I assume that this position hosts the L-H% boundary tone in English, and the CT particle *ne* in Mandarin. The composition of a nested f-value is shown to the right of (21).[5] The f-value output by the CT operator is a singleton containing a function that takes an individual x, and returns the question *What did* x *eat*. When we combine this pointwise with the f-value of the CT phrase [Fred]$_F$, we get the set of questions *What did Fred eat*, *What did Mary eat*, and so on.

And what do we do with this f-value? The beauty of the topic abstraction account is that the f-value of a CT utterance gets no special treatment. We bind the focus alternatives with Rooth's squiggle (~) operator as usual. A generalized version of squiggle is given below.[6] On our example, the effect of squiggle will be to add a presupposition that the context contain a set of two or more questions, all of which have the form *What did* x *eat*, and one of which is the question *What did Fred eat*.

(22) a. $[\![\sim\phi]\!]^o = [\![\phi]\!]^o$

b. $[\![\sim\phi]\!]^f = \{ [\![\phi]\!]^o \}$

c. … and presupposes that the context contain an antecedent C such that:

i. $C \subseteq [\![\phi]\!]^f$

ii. $|C| > 1$

iii. $[\![\phi]\!]^o$ *$\in$ C "C contains $[\![\phi]\!]^o$ somewhere within it."

What does it mean to say that the discourse contains a set of questions as an antecedent? Just as a set of propositions represents a question, we can understand a set of questions as a single complex question or discourse strategy. Thus, my account, like Büring's, predicts that a CT utterance depends on the salience of a potentially implicit strategy of questions of a particular shape. That is to say, we have derived Büring's congruence condition directly from the more general squiggle.[7]

Note that positing a strategy of questions as an antecedent for anaphora does not commit us to the view that any linguistic form is denoting, or even *could* denote an entire discourse strategy. However going this extra step is quite natural, and would be in line with the view that multiple wh- questions can have sorted meanings (Hagstrom 1998), so that for example "Who ate what" could denote (among other things) the sorted question *For each person, what did they eat*. Indeed, languages may choose to mark different sortings of multiple wh- questions overtly (Dayal 1996, Šimík 2010). The topic abstraction account provides a simple way of generating these meanings under a Beck-style (2006) semantics for

[5] In this computation, and throughout, I am ignoring the world argument for the sake of simplicity. The proposal should be understood as embedded in an intensional semantics where propositions are type ⟨s,t⟩.

[6] The only modification necessary was to (22c.iii). Rooth's requirement that $[\![\phi]\!]^o$ be a member of the antecedent C is too strict to work with nested f-values. For example, the proposition *Fred ate the beans* is not a member, but rather a member of *a member* of the f-value in (21). Thus, we loosen this condition to require only that $[\![\phi]\!]^o$ occur *somewhere within* C, using the "ancestral membership" relation discussed by Quine (1963: §15), who traces the definition of the ancestral and the star notation to Frege's *Begriffsschrift*. Note that this modification has no effect on standard cases where the f-value is non-nested.

[7] There is a small difference in that Büring stipulates that the CT utterance itself must directly answer a particular sub-question in the strategy, whereas the present account merely requires that the strategy as a whole be salient. I do not see any way of distinguishing between these two positions empirically, so opt for the simpler version, which parallels Rooth's treatment of simple question-answer congruence.

questions, where wh- words generate focus alternatives but have no ordinary semantic value, and a Q operator unselectively binds all focus within its scope, as in (23). By topic abstracting one wh- word above the Q operator as in (24b), we generate a complex question sorted by that wh- word. A direct prediction of this approach is that in languages with dedicated forms for sorted multiple wh- questions, the wh- word we are sorting by will display features of topic, for example by raising overtly to a CT position. These predictions seem consistent with the facts discussed by Willis (2008) and Šimík (2010), but I do not explore the issue further here.

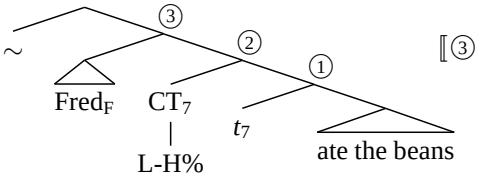
(23) a. $[\![\text{what}]\!]^o$ = undefined
b. $[\![\text{what}]\!]^f = D_e$
c. $[\![\text{Q } \phi]\!]^o = [\![\phi]\!]^f$
d. $[\![\text{Q } \phi]\!]^f = [\![\phi]\!]^f$

(24) a. $[\![$ Q who ate what $]\!]^o$ = {Fred ate beans, Mary ate pasta, … } = 'What eater/eaten pairs were there?' **Flat Question**

b. $[\![$ Q who CT_7 t_7 ate what $]\!]^o$ = 'For each person, what did they eat?' **Sorted Question**

Returning to the core data, (25) illustrates how the account works on a case of lone CT. Following Büring (2003) and Biezma & Rawlins (2011), I take a singleton containing a proposition to represent a polar question. Thus, as on Büring's account, (25) invokes a strategy of polar questions of the form *Did x eat the beans?* However something additional needs to be said about the prosody of this example. If the L-H% boundary tone spells out the left-peripheral CT operator, how does it get to be realized sentence-finally? Here, I sketch a phonological account. Suppose we treat L-H% as an intonational phrase enclitic, so that it must be IntP-final. Furthermore, a constraint *INTP pressures against the creation of extra intonational phrases, as in Féry 2007. Thus, all else being equal, a sentence with CT will contain only a single IntP, and the L-H% boundary will spell out sentence-finally. The need for more than one intonational phrase stems from a competing constraint which asks that the pitch accent associated with any alternative-generating focus be the head of its own IntP—cf. Féry & Samek-Lodovici's (2006) STRESS-FOCUS. If this constraint outranks *INTP, and all else is equal, CT+Exh and Exh+CT structures will be realized with two intonational phrases, whereas lone CT will be realized with one.

(25) "[Fred]$_{CT}$ ate the beans…"



$[\![③]\!]^f = \left\{ \begin{array}{c} \{\text{Fred ate the beans}\} \\ \{\text{Mary ate the beans}\} \\ \dots \end{array} \right\}$

= 'For each person, did they eat the beans?'

Having dealt with Büring's core data, we can now turn to the problematic data. First, we have CT questions. Given the semantics for wh- questions from (23), we capture the discourse congruence of CT questions by abstracting the CT phrase above the Q operator, as in (26). Note that here, as above, I'm ignoring wh- movement for simplicity. However as long as the wh- landing site is below the CT operator, it will not affect the derivation. The question of why English doesn't typically realize CT as L-H% in questions remains, but crucially, we have a semantics for CT questions in general.

(26) a. (And) what did [*Fred*]$_{CT}$ eat?
b. $[\![$ Fred$_F$ CT_6 Q t_6 ate what $]\!]^f$ = 'For each person, what did they eat?'

Moving on to multiple CT examples, the topic abstraction account captures the fact that when topicalization is overt, the order of the topics reflects their discourse scope. Each CT operator adds an extra layer of nesting in the focus dimension, so as long as each CT phrase moves to a unique CT operator position, we predict congruence to a nested strategy sorted by one topic over the other, as in (27). Note that with CT in-situ, the movement is covert, so unless we impose additional restrictions on

that covert movement, no prediction will be made as to the relative scope of in-situ CT phrases.[8]

(27) a. [On *Sundays*]$_{CT}$ … [*Fred*]$_{CT}$ … [*rests*]$_{Exh}$.

b. ⟦ on Sundays$_F$ CT$_2$ Fred$_F$ CT$_1$ [t$_1$ rests$_F$ t$_2$] ⟧^{f}
= 'For each day… [For each person, what do they do?]'

Since the abstraction account is movement-driven, we expect to see sensitivity to whether the CT phrase is island-internal. On the surface, this prediction is not borne out. For example, in (28), CT occurs inside a coordinate structure and a relative clause without any problem. However we can make sense of these cases if what covertly raises is not the CT phrase alone, but the entire CT-containing island.[9] Covert island-raising for island-internal CT is argued for independently by Davis (2010) based on the island-obeying distribution of Japanese CT *wa* discussed in Hara 2006.

(28) a. [*Fred*]$_{CT}$ and Mary … would be [*good*]$_{Exh}$ teammates.
b. The painting that [*Mary*]$_{CT}$ drew of Fred … was [*spectacular*]$_{Exh}$.

As long as nothing else within the island is F-marked, the abstraction semantics will come out the same regardless of the amount of material that pied-pipes along with the CT phrase. Thus, the island-raising account leads us to predict that CT will be possible island-internally *unless* an exhaustive focus also occurs in the same island. This is precisely the pattern that we observe in the following examples. In the (a) forms, CT and Exh cohabit an island, and—to the degree that the CT boundary tone and IntP break are rendered clearly—the sentences are judged deviant. By contrast, the (b) forms, which convey the same strategy, but without placing Exh inside the island, are natural.

(29) (What about *Fred*? Who should we pair *him* with?)
a. ??[*Fred*]$_{CT}$ … and [*Mary*]$_{Exh}$ would be good teammates.
b. [*Fred*]$_{CT}$ … would be a good teammate for [*Mary*]$_{Exh}$.

(30) (What about *Mary*? Which of *her* paintings was the best?)
a. ??The painting that [*Mary*]$_{CT}$ … drew of [*Fred*]$_{Exh}$ was the best.
b. The best painting [*Mary*]$_{CT}$ drew … was the one of [*Fred*]$_{Exh}$.

One final technical concern warrants discussion. The semantics for topic abstraction in (20) imply that both functions to alternative sets, and nested alternative sets are permitted as basic types in our ontology. This raises the question—do we need to define new composition rules to dictate how all the combinations of these complex types compose? For example, could a set of properties combine with a set of sets of individuals (to produce a set of sets of propositions)?[10] Or could a generalized quantifier combine with a function from individuals to sets of propositions (giving a set of propositions)? I have assumed throughout that only standard pointwise composition is available, and that non-canonical combinations like these are undefined. Sticking with a lean set of composition rules keeps the account simple, but also makes important predictions about the interaction of CT and quantifiers.

Consider the CT-marked quantifier *all* in (31a). On our movement-driven theory of CT, this quantifier (or some containing phrase) will undergo topic raising and be interpreted in a high-scope position, as in (31b). Does this imply that the quantifier will take wide scope, over negation? We should

[8] It is not immediately apparent whether *Fred* in (27a) has raised from subject position. If not, we may need an additional constraint that if one CT raises overtly and another covertly, the overt movement is to the higher position. I assume that the adjunct *on Sundays* is generated low in VP, but this could also be questioned. Overall, what is needed here is just some way of ensuring that the surface order of the CT's in (27a) reflects their relative scope.

[9] Another approach would be to hold that the entire complex DP island is F-marked. Here, the challenge would be to say both why stress falls earlier than expected within the F-marked CT phrase, and why only focus alternatives that vary in the narrow stressed position are available.

[10] It is critical here to distinguish between a function (e.g. from individuals to truth-values) and the characteristic set of that function (e.g. a set of individuals). These encode the same information, but are formally different types.

hope not, since as Büring (1997) observes, only narrow-scope readings of CT-marked *all* are available. But in fact, topic raising alone is not enough to give *all* scope over negation. By comparison, quantifier raising (QR) affects scope relations by allowing a moved GQ—type ⟨⟨e,t⟩,t⟩—to bind a type-e trace. With topic raising however, this scope-taking configuration is unavailable unless we stipulate new composition rules. Specifically, if the trace in (31b) is type-e, the overall f-value will be undefined, since the GQ will be unable to combine with the function to alternative sets returned by the CT operator.

(31) a. [*All*]$_{\text{CT}}$ politicians aren't corrupt… (not > all) variation on Büring 1997: 180

b. ⟦ [[all]$_{\text{F}}$ politicians]$_{\text{DP}}$ CT$_7$ NEG t$_7$ corrupt ⟧^{f}

Given that the trace left by a raising CT is the same type as the CT phrase itself, and given the semantics of topic abstraction in (20a), topic movement will never affect meaning in the ordinary dimension, and thus never affects scope relations. The only effect of raising a phrase to the CT operator position will be to induce nesting in the focus dimension, where that phrase's alternatives will be sorted out above others'. But if topic raising is inert for the purposes of scope-taking, then we need to ask how CT-marked quantifiers *ever* take wide scope. On the most salient reading of (32), for example, the CT-marked *some* scopes above the object quantifier.

(32) [*Some*]$_{\text{CT}}$ students … solved [less than *three*]$_{\text{Exh}}$ problems.

a. 'Some students x are such that x solved less than three problems.' (Subj$_{\text{CT}}$ > Obj$_{\text{F}}$)

b. 'Less than three problems x are such that some students solved x.' (Obj$_{\text{F}}$ > Subj$_{\text{CT}}$)

One option for generating the wide-scope CT reading here would be to allow for topic-raising to apply to the output of QR, as in (33). However, I take this to be the wrong approach, since it predicts the availability of wide-scope CT irrespective of the quantifier involved. As the contrast between (32) and (34) illustrates,[11] wide-scope CT readings are only an option for quantifiers that can take exceptional wide-scope in the sense of Reinhart 1997. Thus, it is reasonable to maintain that the same phrase cannot undergo both QR and topic-raising, with the result that CT-marked GQ's will always take narrow scope.[12] Cases where a quantifier is CT-marked and receives wide scope should be captured using an independent non-GQ mechanism by which indefinites get exceptional wide scope generally. One implementation compatible with the present account is to allow "referential" type-e interpretations for a subset of quantifier phrases using a choice-functional system along the lines of Reinhart (1997). For the details of how this treatment of quantifiers can be applied to CT data, see Rooth (2005) and Constant (2012).

(33) [[some]$_{\text{F}}$ students]$_{\text{DP}}$ CT$_3$ t$_{3\,(\text{GQ})}$ λ_2 [[less than three]$_{\text{F}}$ problems]$_{\text{DP}}$ λ_1 t$_{2\,(\text{e})}$ solved t$_{1\,(\text{e})}$

(34) [*Few*]$_{\text{CT}}$ students … solved [less than *three*]$_{\text{Exh}}$ problems.

a. *'Few students x are such that x solved less than three problems.' (*Subj$_{\text{CT}}$ > Obj$_{\text{F}}$)

b. 'Less than three problems x are such that few students solved x.' (Obj$_{\text{F}}$ > Subj$_{\text{CT}}$)

To briefly conclude, the topic abstraction account is noteworthy both for its simplicity, and for the mileage it gets out of Rooth's squiggle (∼) operator. Despite this simplicity, it covers a range of complex and widely problematic data—CT questions, multiple CT, island-internal CT, and CT quantifiers. Finally, unlike purely in-situ theories, the abstraction account makes sense of the connection between CT meaning and the overt topicalization of CT's to a high-scope position. The nature of this movement, and the precise syntax of CT constructions across languages are areas for future exploration.

[11] Both (32b) and (34b) require contextual support for contrasting proportions. A supporting question for (34) would be "And what about *few* students? How many problems did *few* students solve?" Note also that while pragmatic factors alone can account for the impossibility of wide-scope CT *all* (cf. Büring 1997), these explanations are not enough to capture the impossibility of wide-scope CT *few* or other non-maximal decreasing quantifiers.

[12] This could be taken to be an instance of a more general constraint against one movement chain containing traces of two different types.

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