Topic Accents on Quantifiers

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July 13, 2004

1 Introduction

Examples (1)—(3) illustrate the pattern of paired accents which was discussed in Bolinger (1965) and Jackendoff (1972), and analyzed in depth in Büring (1995,1997) . I mark one of the accents—the B accent in Bolinger's and Jackendoff's terminology—with a rising line, and the other—the A accent—with a falling line.[1]

(1) Where do Anna and Fred live?
/Fred lives in Freeville\.

(2) What about Anna? Who did she come with?
/Anna came with Manny\.

(3) What about Manny? Who came with him?
Anna\ came with /Manny.

Büring (1995) proposed that B and A accents are phonological markers of distinct focus-like features T and F, and analyzed the semantic/pragmatic import of T in alternative semantics, extending the alternative semantics analysis of focus features of Rooth (1985). The B accent realizes the syntactic T feature, while the A accent fealizes F; the feature analysis of (1) is (4).

(4) Fred_{T} lives in $\text{Freeville}_{\text{F}}$.

The semantics of F is given by alternative semantics: an F feature, when interpreted with propositional scope, signals a set of "alternative" propositions, which are obtained by making substitutions in the position corresponding to the focused phrase. In (4), the alternative propositions are formed by making substitutions in the *Freeville* position, giving propositions

[1] Examples (2) and (7) are from Mark Liberman and Janet Pierrehumbert's study of the intonation of AB patterns, Liberman and Pierrehumbert (1984). Note that in (3), the B accent follows the A accent.

such as 'Fred lives in Collegetown' and 'Fred lives Downtown'.[2] [3] The set of these propostions can be called a question, using the modeling of question meanings as sets of atomic answers (Hamblin 1973). I will call this set of propositions the local question signaled by the focus.[4] This analysis of the F feature is illustated in (5b,c).

(5) a. Syntax: Fred_{T} lives in $\text{Freeville}_{\text{F}}$
    b. Focus alternatives: propositions of the form 'Fred lives in y'.
    c. Local question: where does Fred live?
    d. Topic alternatives: questions of the form 'where does x live'

Büring (1995, 1997) extended this framework to cover T features by adding another level of alternatives. Just as F features evoke sets of alternative propositions (i.e. questions), T features indicate alternatives to the local question. The T feature in (4) signals alternative questions of the form 'where does x live', which are obtained by making substitutions in the local question in the position of the T-marked phrase *Fred*. These questions can be viewed as as contrasting (or potentially contrasting) with the local question 'where does Fred live'. Notice that in (1) there is an obvious contrasting question 'where does Anna live' which is left open by the answer (1b). Since this question is formed from the local question 'where does Fred live' by making a substitution in the position of *Fred*, it is a member of the topic semantic value of the answer.

This paper will look at BA examples where the B accent falls on or within a phrase denoting a generalized quantifier, as in (2)–(8).[5]

(6) a. Where does Anna live?
    b. /MOST grad students live DOWNTOWN\.

(7) a. Where do the grad students live?
    b. /MANY grad students live in FREEVILLE\.

(8) a. Which faculty live in which dorms?
    b. The /FEMALE faculty live in LINCOLN\.

[2] I use sentences enclosed in single quotes as informal names for propositions. Italics are used as a quotational device for single words, and labeled bracketings are used without additional quotation as names for syntactic trees. So for instance 'Anna came with Fred' is the proposition denoted by $[_{\text{S}}$ Anna came with Fred].

[3] This terminology of substitution should be regarded as shorthand; I do not want to commit myself to the idea that propositions have positions corresponding to words or phrases. In Rooth (1985), the terminology of substitution is replaced by a recursive definition of focus alternatives.

[4] The basis for the terminology is seen in (1), where the focus feature can be viewed as echoing not the overt global question *where do Anna and Fred live*, but an implicit local question *where does Fred live*.

[5] Such examples are discussed and analyzed in chapters 3 and 4 of Büring (1995). His analysis will be reviewed in sections 2 and 3.

These quantificational examples are parallel to (1)—(3) in several ways. First, intonationally they appear to have BA accent patterns. This is indicated by minimal pairs which contrast T-marked phrases which denote individuals with T-marked determiners:

(9) a. Which grad students live where?
b. /JUAN lives in FREEVILLE\.
c. /ONE lives in FREEVILLE\.

Example (9a) has a B-accent on the type e subject *Juan*, and an A-accent on *Freeville*. Example (9b) has a B-accent on the determiner *one* and the A-accent again on *Freeville*. Intonation appears to be identical in the two versions, and if one pronounces *Juan* homophonously with *one*, the versions appear phonetically indistinguishable.

Correlations between phrasing and the breadth of focus features also indicate parallel representations for quantified and non-quantified examples. The answer in (10) can be phrased either with a major intonational break after $[_{\text{DP}}$Anna-Kate] as in (10b), or with the major break later in the sentence, as in (10c). The intonational break is marked with "\\ ".

(10) a. Which grad students ate what?
b. /ANNA-KATE \\ ate APPLE-PIE\.
c. /ANNA-KATE ate \\ APPLE-PIE\.

The question context (10a) indicates an F feature on the object $[_{\text{DP}}$apple pie], as in (11). Apparently, this syntax is compatible with either phrasing pattern. I assume this is to be captured in the map between syntax and phonology.

(11) Anna-Kate$_{\text{T}}$ ate $[_{\text{DP}}$apple-pie$]_{\text{F}}$.

Switching to a context which indicates a focus on the VP, as in (12)-(13) results in different phrasing possibilities, with the late phrasing break in (12c) being impossible or marginal in context.

(12) a. Which grad students did what?
b. /ANNA-KATE \\ ate APPLE-PIE\.
c. ?? /ANNA-KATE ate \\ APPLE-PIE\.

(13) Anna-Kate$_{\text{T}}$ $[_{\text{VP}}$ate apple-pie$]_{\text{F}}$.

I assume that constraints in the syntax-phonology map allow the syntactic structure (13), with its paired T and F accents, to be realized with the major intonational break after the T-marked subject, as in (12b), but not with the major break within the F-marked VP, as in (12c). (14)–(15) show that this pattern is repeated in quantified examples. In a context (14a) which triggers a T-marked subject and an F-marked object, either phrasing pattern is possible. When the F is moved to the VP, the version (15c) with

the major break before the object becomes impossible or marginal.[6]

(14) a. Which grad students ate what?
b. /ABOUT EIGHT \\ ate APPLE-PIE\.
c. /ABOUT EIGHT ate \\ APPLE-PIE\.

(15) a. Which grad students did what?
b. /ABOUT EIGHT \\ ate APPLE-PIE\.
c. ? /ABOUT EIGHT ate \\ APPLE-PIE\.

These phonetic data tend to support the hypothesis that quantified examples have the same phonological and feature analysis as corresponding non-quantified ones. In (2), the obvious possibility is that the metrically prominent determiner bears the T accent:

(16) a. /MANY grad students live in FREEVILLE\.
b. Many_{T} grad students live in $\text{Freeville}_{\text{F}}$.
c. $[\text{Many grad students}]_{\text{T}}$ live in $\text{Freeville}_{\text{F}}$.

Büring (1997) suggested this feature analysis, and proposed that it was forced by rules of projection which relate accent positions to the syntactic locus of T and F features. Given that the B accent in (16) is phonologically associated with the first syllable of *many*, he suggests, the projection rules allow for a T feature on *many*, but not for a T feature on [many grad students] as in (16c), for instance.[7]. This conclusion actually needs to be re-examined in light of subsequent work on focus projection, especially Schwarzschild (1999). But in this paper I will assume the feature analysis (16b).

Another similarity between quantificational and non-quantificational examples is pragmatic. Uses of sentences with BA accent patterns often have a partial-answer pragmatics; in the example below, the answer is partial in that it leaves open the question of where the linguistics faculty other than Sally live.

(17) a. Where do the linguistics faculty live?
b. /SALLY lives in Belle SHERMAN\.

The pragmatics of the quantificational variant (18b) is similar, in that leaves open the question of where the rest of the faculty live (and also, the question of who the faculty who live in Belle Sherman are). So the quantificational example (18b) has a BA accent pattern and a partial answer pragmatics; this is reason to explore a hypothesis that quantificational and non-quantificational examples both have a syntactic feature analysis with paired T and F features, and to try to apply a single theory of T and F interpretation to both kinds of examples.

[6] I find the contrasts fairly clear, and have the feeling that if the sequences (12a,c) or the sequences (15a,c) become possible at all only because of hesitations.

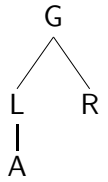
[7] See Büring 1997, p62-63

(18) a. Where do the linguistics faculty live?
b. /SOME of them live in Belle SHERMAN\.
c. Where do the others live?
d. Which ones?

To finish up this introductory section, I will introduce some formalisms and notation which will be used later. Roberts (1996) and Büring (2003) among others theorize about question-answer dialogues in terms of tree-structured objects. Question-answer dialogues have tree structures, where questions dominate corresponding answers, and also dominate subquestions, that is to say questions they entail. The dialogue (19) is said to have the discourse tree structure (20).[8]

(19) a. Which faculty live in which dormitories?
b. Which dormitory does Polly live in?
c. Polly_{T} lives in $\text{Spartan}_{\text{F}}$.

(20)



G is the multiple-wh question (19a), L is the subquestion (19a), and A is the answer (19c). R is a contrasting subquestion such as 'where does Sally live'.

If we assume that (20) is a semantic object, then sentence (19c) is related to the discourse tree (20) in the following way. The answer A corresponds to the ordinary semantics of (19c), the sub-question L is the focus semantic value of (19c), and R is an element of the topic semantic value of (19c) which is distinct from L.

The sub-question and answer relations in (20) are logical ones. The question (19a) combined with the assumption that Polly is one of the faculty entails the question (19b); see Groenendijk and Stokhof (1984). And according to a logical notion of partial answerhood (see especially Groenendijk 1999), (19c) is an answer to (19a) as well as to (19b), on the assumption that Spartan is a dormitory and Polly is a faculty member.

Rooth (1992) introduced the hypothesis the questions evoked by focus features are represented as free variables in compositional structure. (21) is the representation of a question-answer pair. The F feature is interpreted at the level of the answer by an operator $\sim$, and contrains a variable with the question type, which represented by a referential index 1. The antecedent for that index is the question.

(21) $[\text{Where does Juan live?}]_1$

[8] Roberts actually phrases her theory in terms of a dynamic stack of discourse moves. If constraints refer to current stack states, this potentially has different consequences from postulating a tree structure to which constraints can refer.

[He lives in Collegetown$_{\mathrm{F}}$]$\sim$ 1

Büring's hypothesis about T-interpretation can be integrated into this reprentational hypothesis by adding an additional question variable. In the representation (22) parallel to (20), 1 corresponds to the local question L, and 2 corresponds to the contrasting question R.

(22) [Which faculty live where]
(Where does Polly live)$_1$
[He lives in Collegetown$_{\mathrm{F}}$]$\sim$ 1, 2
(Where does Sally live)$_2$

This concludes my introductory exposition. Section 2 of this paper presents and criticizes one application of alternative semantics for T/F to quantificational data. Section 3 presents and criticizes a variant account which is discussed in Büring (1997). Sections 4-6 introduce my own proposal, which retains the alternative semantics architecture, but revises both the compositinal semantics of T and the hypothesis about the indexing of variables constrained by T/F interpreation into discourse trees.

2 Determiner alternatives

Stated informally, the alternative semantics for T features from Büring (1995) proceeds by

(i) first generating a set of propositions by making substitutions for the F-marked phrase, and then

(ii) generating alternative questions (alternative sets of propostions) by making substitutions in the local question defined by (i) in the position of the T-marked phrase.

If we apply (i) to (23), propositions such as those denoted by the sentences in (24) are generated.

(23) Many$_{\mathrm{T}}$ grad students live Downtown$_{\mathrm{F}}$.

(24) a. Many grad students live in Collegetown.
b. Many grad students live in Belle Sherman.
c. Many grad students live in Fall Creek.
d. Many grad students live in Cayuga Heights.
e. Many grad students live in Forest Home.
f. Many grad students live in Northwest.

The set of such propositions corresponds to the question (25), or equivalently (26).

(25) Where/in which neighborhoods do many grad students live?

(26) Which neighborhoods have many grad student residents?

In step (ii), topic alternatives are generated by making substitutions in the local question in the position of the T-marked phrase. If the alternatives for *many* are other quantificational determiners, this produces questions such as those in (27), where *all, most, some, three* and *no* are the alternatives for *many*.[9]

(27) a. Where do all graduate students live?
b. Where do most graduate students live?
c. Where do some graduate students live?
d. Where do three graduate students live?
e. Where do no graduate students live?

In the account sketched in Section 1, focus and topic semantic values are used as partial specifications of structured question-answer dialogues. Generally, the focus semantic value functions as a local question for the overt sentence, while a contrasting or residual question is selected from the topic semantic value. Suppose that (23) is used as an answer to the overt question (28), as it certainly can be.

(28) Which grad students live where?

The overt question (28) is not an element of the topic set (27), and it differs from the focus question (25). Therefore the topic/focus information could not be directly constraining the overt question. However, local and contrasting questions indicated by the focus and topic semantic values could be construed as implicit questions in a discourse along the lines of (29), where the implicit questions are given in parentheses.

(29) a. Which grad students live where?
b. (Where do many grad students live?)
c. Many_{T} grad students live $\text{downtown}_{\text{F}}$.
d. (Where do several grad students live?)

This analysis with implicit questions in once sense plausible, in that it is parallel to examples with topic marking on an individual-denoting phrase. In (30), the focus constrains an implicit local question (30b), while the topic semantic value constrains the residual question (30d).

(30) a. Which grad students live where?
b. (Where does Anna live?)
c. Anna_{T} lives $\text{downtown}_{\text{F}}$.
d. (Where does Manny live?)

At a strictly at an intuitive level, I think there is no feeling that (29c) when used as an answer to (29a) evokes the implicit question (29b), or an implicit followup question along the lines of (29d). Here is a variant which seem even less plausible.

[9] Büring (1997, p 89-90) proceeds in exactly this way; I will review his examples and analysis in the next section.

(31) a. Which grad students live where?
b. (Where do five grad students live?)
c. Five_{T} grad students live $\text{downtown}_{\text{F}}$.
d. (Where do four grad students live?)

Intuitions of intuitive implausibility of implicit questions are relevant to the extent that the contrasts evoked by topic and focus are accessible to intuition. At least often, someone who uses sentence with topic marking has a specific contrasting question in mind, and intends for the listener to identify that contrasting question.[10] In the case of (31c) in the context of (31a), I think it is fairly obvious that (31d) is not the intended contrasting question.

In examples like (32), there is a suggestion that the implicit question is answered completely. In this case, there is a defeasible suggestion (probably with the status of a conversational implicature) that Anna danced with nobody other than Manny. In contrast, in (31), I think there is no suggestion that the supposed implicit question (31b) is being answered completely. A complete answer would list all neighborhoods which are occupied by five grad students; this corresponds to the fact that (31b), viewed as a set of propositions, has as alternatives to *Downtown* substituted in the position of the focused phrase:

(32) a. Who danced with whom?
b. (Who did Anna dance with?)
c. Anna_{T}danced with Manny_{F}.

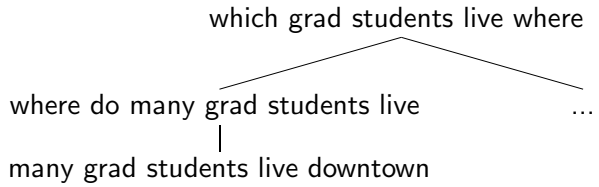
(33) $\left\{ \begin{array}{c} \text{'five grad students live downtown'} \\ \text{'five grad students live in Collegetown'} \\ \text{'five grad students live Fall Creek'} \\ \ldots \end{array} \right\}$

The speaker for (31b) seems to be leaving it entirely open whether any of these other propostions are true, i.e. whether there are any other neighborhoods where five grad students live. This constitutes an argument against the implicit presence of the question (31b): (31b) could not be a subquestion evoked by (31c), because this would trigger an implicature that the subquestion is being addressed completely.

A more formal issue about (31) is whether it fits in with the framework for question-answer dialogues reviewed in Section 1. Here the results are more positive. The question (29a) entails the question (29b), and (29c) is a partial answer to (29b), so that the discourse tree (34) can be hypothesized.

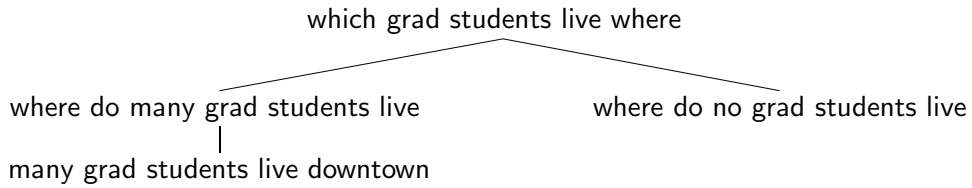
[10] Here I have in mind that information conveyed by prosodic fearures is communicated, in the sense of Grice's theory of conveyed meaning. This ties in with the hypothesis in Rooth (1992) that focus-constrained questions are represented by free variables in LF. Such free variables are given contextually plausible values which are consistent with the constraints imposed by topic/focus semantics, and the speaker conveys his intention that the hearer recover specific values for these variables.

(34)



Second, the questions in the topic semantic value (27) are also entailed by (29a), and (27e), for instance, is left open by (29c). So it could be hypothesized as an implicit followup question in the discourse tree (35).

(35)



So, the implicit-question dialogue (29) exhibits appropriate question/subquestion and question/answer relations. Still, the objections mentioned above remain: the supposed implicit questions are intuitively implausible, and postulating (29b) as an implicit local question wrongly generates an implicature that (29b) is answered completely by (29c).

3 Definite descriptions as topic alternatives

Chapter 4 of Büring (1997) inderectly suggests an analysis of T-marked determiners which is nearly identical to what I discussed in section 2 in its assumptions about topic semantic values, but importantly different in the hypothesis about discourse structure. I will review the analysis with reference to examples from Büring (1997,p.89-90). The original examples are in German, but for these data the intonational distinctions and semantic/pragmatic effects appear to be identical in the two languages.

Examples (36) and (37) are BA patterns with a topic accent on the determiner in the subject, and a focus accent on the infinitival verb phrase.[11]

(36) a. Ein PAAR Cowboys beschlossen, zu HAUSE zu bleiben.
b. SOME_{T} cowboys decided [to stay at HOME]$_{\text{F}}$

(37) a. FÜNF Jungen gingen zur ARMEE.
b. FIVE_{T} boys joined the ARMY_{F}

Büring argues that these examples fall under his general semantics and pragmatics of T and F, in the following way. Just as in the analysis of Section 2, in (36b), topic semantics produces the set of questions of the form 'what did D cowboys decided on', where D is an alternative to *some*. If one lets D vary over natural language determiner meanings (which is what Büring suggests) this topic semantic value contains the questions denoted by examples

[11] These examples are from page 89 of Büring (1997). (38) is from page 90.

(38a-f).[12]

(38) a. What did the cowboys decide on?
b. What did all cowboys decide on?
c. What did most cowboys decide on?
d. What did some cowboys decide on?
e. What did two cowboys decide on?
f. What did no cowboys decide on?

Along the same lines, the topic semantic value for (37) includes the sets of propositions denoted by the questions (39).

(39) a. What did the boys do?
b. What did most boys do?
c. What did five boys do?
d. What did three boys do?
e. What did no boys do?

These topic alternative sets are like what was discussed in Section 4, except that *the* is inluded as a determiner alternate. When we reconstruct a discourse structure by the procedure of Section 4, we obtain results which are implausible in the same way as before:

(40) a. What cowboys decided to do what?
b. (What did five cowboys decide on?)
c. /FIVE cowboys decided to stay HOME\.
c. (Okay. What did two boys decide on?)

However, Büring suggests a a different discourse structure which uses *the* as the alternative for the topic-marked determiner. He initially approaches the problem of identifying the question constrained by T interpretation in (37) somewhat abstractly:[13]

> Although we can't find out which of the questions was *the* D-Topic, it is obvious that all the possible questions have a common denominator: they are all about cowboys who decide on something. By virtue of the Topic/Focus/Background structure of a sentence S we can thus reconstruct the set of possible D-topics, which equals the set of possible preceding (or implicit) questions. If these questions have something in common, that something can inferred to be part of the Common Ground at the time of the utterance S. Yet another way of viewing this is the following: given that everything new in the sentence must be either part of the S-topic or part of the Focus, we can reconstruct at least part of the Common Ground c by trivializing both the

[12] (38) is Büring's example (5) in Chapter 4, and (37) is example 3.

[13] The passage is from Büring (1997), p 90. Where Büring used the notation CG for the propositional common ground, I have substituted c.

> Topic and the Focus value. For every sentence S it holds that $c \subset \bigcup\bigcup [\![S]\!]^{t}$.

The first part of the passage states the general fact that the topic semantic value is intepreted as the set of potiential discourse questions, or D-topics in Büring's terminology. In different scenarios, different options for the D-topic might be realized. The second part of the passage tries to generalize about what kind of context (36) could fit into, using assumptions about the relation between D-topics and a propositional commond ground c. One way of understanding the formula $c \subset \bigcup\bigcup [\![S]\!]^{t}$ is that for any question q which is topical in the discourse, we should have $c \subseteq \bigcup q$, because questions do not carry propositional information.[14] Since $[\![S]\!]^{t}$ is the set of possible q's, we can conclude that any possible pair of a common ground c and a D-topic q satisfy (41a). By existential closure, any possible common ground c satisfies (41b), from which (41c) follows. This is nearly the same as Büring's (41)d.

(41) a. $q \epsilon [\![S]\!]^{t} \wedge c \subseteq \bigcup q$
b. $\exists q\, [q \epsilon [\![S]\!]^{t} \wedge c \subseteq \bigcup q]$
c. $c \subseteq \bigcup\bigcup [\![S]\!]^{t}$
d. $c \subset \bigcup\bigcup [\![S]\!]^{t}$

When one applies this technical idea to the topic semantic value of (36b), as described in (38), a problem crops up. The topic semantic value contains the questions denoted by (38d) and (38f). The first of these in turn contains the proposition indicated in (42a), for various choices of R, while the second contains the proposition indicated in (42b), for various choices of R.

(42) a. Some cowboys decided to R.
b. No cowboys decided to R.

But for any R, these two propositions are complements, so that their union is the the trivial proposition which contains all worlds. It follows that $\bigcup\bigcup [\![S]\!]^{t}$ is also the proposition which contains all worlds. This makes the conditions (41c) and (41d) trivially true, so that they impose no constraint on propositional common grounds.

It remains possible to try to figure out which of the discourse questions in (38) is active in particular scenarios for (36). Büring does not make a suggestion about (36), but elswhere he points out that (44) is a plausible discourse topic for (43).

(43) [THREE]$_{T}$ boys [WALKED]$_{F}$to the station.

(44) How did the boys get to the station?

Here is how he puts it:

> If we reconstruct the set of possible D-topics in the way discussed in subsection 4.1.1 (i.e. by trivializing both the Topic and

[14] I don't know whether this is the justification which Büring has in mind.

> Focus alternatives) we end up with questions far more specific than those behind [example not quoted here]. The D-topic for [(43)] must be about boys getting to the station in one way or another. [(44)] would be one such question.

Trivializing is the double union operation presented above. Also in the current example, this operation produces the set of all possible worlds, and a trivial constraint on the common ground. The fact remains that, intuitively, (44) is a plausible discourse question for (43). If we apply the same strategy to (36b), we obtain a plausible-seeming question-answer sequence, with the pragmatics of a partial answer:

(45) a. What did the cowboys decide on?
b. SOME$_{\mathrm{T}}$ cowboys decided [to stay at HOME]$_{\mathrm{F}}$

This looks like a general solution to the problem of identifying a question signaled by T-marked quantificational determiners. Namely, a discourse question is generated by substituting the determiner *the* for the topic-marked quantifier. The analysis fits in with alternative semantics for T, on the assumption that the definite-description meaning is a legitimate alternative for quantificational determiners. Büring explicitly suggests this discourse structure for (43), and the hypothesis is also compatible with what he says about (36), where an alternative question generated with *the* is included in the topic semantic value.

But examining the topic semantic value for (45b) reveals a problem. The set is generated by (i) picking a determiner meaning D, and (ii) holding D constant, forming a set of propositions of the form 'D cowboys decided to R', for various choices of R. Here is the result if we let D vary over three determiners (*the*, *many*, and *every*) and let R vary over three predicates (*staying home*, *going to a rodeo*, and *going to a saloon*).

(46)
$$\left\{ \begin{array}{l} \left\{ \begin{array}{l} \text{'the cowboys decided to stay home'} \\ \text{'the cowboys decided to go to a rodeo'} \\ \text{'the cowboys decided to go to a saloon'} \end{array} \right\} \\ \left\{ \begin{array}{l} \text{'many cowboys decided to stay home'} \\ \text{'many cowboys decided to go to a rodeo'} \\ \text{'many cowboys decided to go to a saloon'} \end{array} \right\} \\ \left\{ \begin{array}{l} \text{'every cowboy decided to stay home'} \\ \text{'every cowboy decided to go to a rodeo'} \\ \text{'every cowboy decided to go to a saloon'} \end{array} \right\} \end{array} \right\}$$

Let q_{the} be the set of propositions listed first above, obtained by picking *the* (or rather, it's denotation) as the determiner-meaning D. Supposedly, the constraints contributed by T-marking are satisfied by virtue of q_{the} being the denotaton of the question (45a). Notice however that (45a) is understood as equivalent to the multiple-wh question (47). And in particular, (45) is construed in a way which allows for different choices of R for different cowboys, for instance as in (48).

(47) Which cowboy decided to do what?

(48) a. Bill dedided to stay home.
b. John decided to go to a saloon.
c. Tom decided to go to a rodeo.

In contrast, the elements of q_{the} indicate a single choice of R for all the cowboys. In other words, the elements of q_{the} are propositions describing courses of action which the cowboys each decided on.

The upshot of this is that the Büring's semantics for topic does not license his analysis of (45), where the meaning of the question (45a) is supposed to be an element of the topic semantic value for the answer (45b). Notice that if we substitute the multiple-wh question into (45), we have a coherent and equivalent-seeming discourse:

(49) a. Which cowboy decide on what course of action?
b. $\textsc{some}_{\mathrm{T}}$ cowboys decided [to stay at $\textsc{home}]_{\mathrm{F}}$

This supports the idea that the reading of (45) which is perceived as good is one where the question is construed as equivalent to a multiple wh question. In (49) we have the same problem as before: the semantics of topic does not license an analysis where the denotation of the question is an element of the topic semantic value of the answer.

The same problem shows up in another place in Büring (1997). The dialogue (50) is analyzed as a narrowing of the question from (51a) to (51b).[15]

(50) What did the pop stars wear?
The $\textsc{female}_{\mathrm{T}}$ pop stars wore $\textsc{caftans}_{\mathrm{F}}$.

(51) a. What did the pop stars wear?
b. What did the female pop stars wear?

Büring explains the point by stating that the topic semantic value of the answer in (50) is a set of questions along the lines of (52).

[15]This discussion is on page 68 of Büring (1997).

(52)
$$\left\{\begin{array}{l}
\left\{\begin{array}{l}\text{‘the female popstars wore caftans’}\\ \text{‘the female popstars wore dresses’}\\ \text{‘the female popstars wore overalls’}\\ \text{...}\end{array}\right\}\\
\left\{\begin{array}{l}\text{‘the male popstars wore caftans’}\\ \text{‘the male popstars wore dresses’}\\ \text{‘the male popstars wore overalls’}\\ \text{...}\end{array}\right\}\\
\left\{\begin{array}{l}\text{‘the female or male popstars wore caftans’}\\ \text{‘the female or male popstars wore dresses’}\\ \text{‘the female or male popstars wore overalls’}\\ \text{...}\end{array}\right\}\\
\left\{\begin{array}{l}\text{‘the Italian popstars wore caftans’}\\ \text{‘the Italian popstars wore dresses’}\\ \text{‘the Italian popstars wore overalls’}\\ \text{...}\end{array}\right\}
\end{array}\right\}$$

Since the disjunctive property *male or female* is a trivially true property, Büring argues, the third set listed above is equivalent to (53), which matches the overt question in (50). Therefore the denotation of the overt question is an element of the topic semantic value of the answer.

(53)
$$\left\{\begin{array}{l}\text{‘the popstars wore caftans’}\\ \text{‘the popstars wore dresses’}\\ \text{‘the popstars wore overalls’}\\ \text{...}\end{array}\right\}$$

Büring puts it this way:

> “the third element in [52] is the trivial set we are looking for: it matches the meaning of the question ‘What did the pop stars wear?’”

Or does it? The question in (50) is on its most natural reading equivalent to the multiple wh question (54), which has a denotation along the lines of (55). This set consists of atomic answers of the form ‘x wore y’, where x is a popstar and y is a kind of attire.

(54) What popstars wore what?

(55)
$$\left\{\begin{array}{l}\text{Alanis Morissette wore a caftan,}\\ \text{Alanis Morissette wore a dress,}\\ \text{Alanis Morissette wore overalls,}\\ \text{Lisa Germano wore a caftan,}\\ \text{Lisa Germano wore a dress,}\\ \text{Lisa Germano wore overalls,}\\ \text{Avril Lavigne wore a caftan,}\\ \text{Avril Lavigne wore a dress,}\\ \text{Avril Lavigne wore overalls,}\\ \text{...}\end{array}\right\}$$

This multiple-wh question allows for different answers for different popstars. By comparision, (53), which is the third element listed in (52), indicates possible answers where the popstars are described as wearing the same piece of attire.

(55) and are different sets of propostions. Therefore the claim that in (50), the semantic value of the the question is an element of the topic semantic value of the answer is based on a spurious identification of two different sets. One can understand the problem as coming from an equivocation about the interpretation of the question in (50), which is repeated in (56a). On the claimed interpretation (53), (56a) is being read as equivalent to (56b). In fact, on my intuitions, this is not even a possible reading of (56a).

(56) a. What were the popstars wearing?
b. What were the popstars each wearing?
c. What was each popstar wearing?

This distinction is related to the ambiguity of the question (56c), which is ususally considered a scope ambiguity. (56b) is the reading with narrow scope for *each*, and the natural reading of (56c) is the reading with wide scope for *each*. Büring's discussion seems to equivocate between these two readings, in that the narrow-each reading is the one delivered by his semantics, while the wide-each reading is the one appealed to in an intuitive evaluation of (50) and the discourse structure which is claimed for it.

This is essentially the same problem as the one I noted for (45). The problem is deep in Büring's analysis, because we see it already in the focus semantic values of the answers in (45) and (50), where the semantics of F enforces the same answers for different cowboys and different popstars.

4 A global/residual architecture

The general strategy in Büring (1997) can be summarized as follows:

(57) Architecture for T/F interpretation
(i) B an A accents realize distinct features T and F
(ii) The semantics of F is caputured in a focus semantic value, which in Q/A dialogues corresponds to an implicit or explicit local question.
(iii) Focus semantic values are not affected by T.
(iv) The semantics of T is captured in a distinct topic semantic value, which is obtained from the focus semantic value by making substitutions in the position of the T-marked phrase.

The problems in Sections 2 and 3 result from this 4 and 5 result from this architecture, particularly from (iii). In the data I looked at, generating a focus semantic value using the F feature while ignoring the T feature produced problematic or seemingly irrelevant local questions. In (58), deriving a focus semantic value while ignoring the T feature produces propositions of the

form 'many grad studenst live in y'. This focus semantic value corresponds to the local question (60), which intuitively is not evoked by (58b). More significantly, it would generate an implicature that (59) is being answered completely by (58b).

(58) a. Which grad students live where?
b. Many_{T} live in $\text{Collegetown}_{\text{F}}$.

(59) Where do many grad students live?

The probem carries over to the topic semantic value, because making substitutions for *many* in (59) generates another group of questions (60) which do not fit into the discourse (58).

(60) a. Where do all grad students live?
b. Where do most grad students live?
c. Where do some grad students live?
d. Where do no grad students live?

There are a couple of generalizitations about topic-marked quantifiers which are not easily captured in the architecture (57). First, there is an impression that the contextual constraints contributed by intonation is the same in quantificational examples like (61) as in corresponding non-quantificational examples like (62). This leads to the suspicion that we would be better off if (61b) and (62b) had the same focus semantic value, rather than different ones.

(61) a. Which grad students live where?
b. One_{T} lives in $\text{Collegetown}_{\text{F}}$.

(62) a. Which grad students live where?
b. Juan_{T} lives in $\text{Collegetown}_{\text{F}}$.

Second, in examples like (61) with an overt multiple-wh question in the context, there is a simple strategy for relating T and F marking to the overt question. If one replaces both the T and F marked phrases with corresponding wh phrases, on arrives at the overt question. In (61b), by replacing the topic-marked determiner with *which*, and the focus-marked phrase with *where*, one arrives at the discourse question (61a). Büring's architectuere can not directly represent this relation, because the topic-marked determiner is preserved in the focus semantic value, and alternatives to the topic-marked determiner are represented in the topic semantic value.

I will state my approach to these problems in the interface architecture of Rooth (1992), where sentences with focus marking are related to their discourse antecedents by indexing. As reviewed in Section 1, in a typical question/answer dialogue, focus is interpreted at the level of the answer, and focus interpretation contrains a variable with the question type, represented by a referential index. The antecedent for that index is the question. This configuration is illustrated in (63) for an example with only F marking.

(63) [Where does Juan live?]$_1$
[He lives in Collegetown$_{\mathrm{F}}$]$\sim$ 1

I think both of the points above to suggest that Büring (1997) was wrong in claiming that T features to not affect focus semantic values. If we instead assume that T and F features both affect focus semantic values, we can try to apply the indexing architecture to quantificational T/F examples in the way indicated in (64). As in the simple focus example (63), focus interpretation constrains a variable with question type, which is anaphorically linked to the overt question.

(64) [Which grad students live where]$_1$
[One$_{\mathrm{T}}$ lives in Collegetown$_{\mathrm{F}}$] $\sim$ 1

The rough idea for focus interpretation in this example has already been stated: T/F interpretation corresponds to replacing the T and F marked items by appropriate wh-phrases. This will produce a constraint on the referential index 1 which is consistent with the value for that index which is determined by the overt question.

The above amounts to the hypothesis that for the purposes of determining focus semantic values, there is no difference between T and F. But, as Jackendoff (1972) pointed out, examples like (2) and (3) show that T and F are not interchangeable, so a theory of TF interpretation must make a distinction between them somewhere. If we think focus effects are semantically mediated then the differences between T and F must be reflected in the semantics. Rather than changing the interpretation of the variable 1 in (63) to reflect a difference between T and F, I will add a second question variable, which is to be thought of as a residual question. The new representation is exemplified in (64).

(65) [Which grad students live where]$_1$
[One$_{\mathrm{T}}$lives in Collegetown$_{\mathrm{F}}$] $\sim$ 1, 2
(Where do the other grad students live)$_2$

(65) indicates an implicit residual question (65a), which is indexed with the second question variable constrained by focus interpretation. This residual question can also be phrased non-anaphorically, as in (65b).

(66) a. Where do the other grad students live?
b. Where do the grad students who do not live in Collegetown live?

I assume that focus interpretation is similar in non-quantificational answers with topic marking. Here is an example:

(67) [Where do Ana and Maria live]$_1$
[Maria$_{\mathrm{T}}$ lives in Collegetown$_{\mathrm{F}}$] $\sim$ 1, 2
(Where does Ana live)$_2$

The residual follow-up questions in (65) and (66) are intuitively plausible. I assume they are communicated by the utterances with topic marking, by

virtue of the presence in LF of the second question variable by the focus interpretation operator $\sim$.

With regard to the problems with (57) mentioned above, the important point about the representation (64) is that neither the question index 1 nor the question index 2 has a value to which the determiner *many* makes a contribution. This contrasts with the results in Büring's system, where the topic-marked determiner *many* is used in building the focus semantic value, and alternatives to *many* figure in the topic semantic value.

A second point is that the value of the first question index 1 is the same in the quantificational example (64) and the non-quantificational example (65). This captures the intuition that T/F marking in non-quantificational and quantificational examples have something in common in the the constraints they place on context.

5 Compositional semantics

The first technical problem in the plan for an analysis from section 6 is to generate appropriate alternatives for topic-marked determiners. In the example below, instead of substituting quantificational determiners for *many*, one wants to generate alternatives at the individual level, consisting of individual grad students.

(68) a. Which grad students live where?
b. Many_{T} live in $\text{Collegetown}_{\text{F}}$.

Making appropriate substitutions in the F-marked position produces the propositions schematically indicated in (69).

(69) '... lives in Collegetown'
'... lives in Fall Creek'
'... lives in Northwest'
...

In the same process, individual grad students should somehow be substituted in the dotted positions, to generate the set of propositions (70). Assuming the right substitutes are chosen, this set agrees with the question (68a).

(70) $\left\{ \begin{array}{l} \text{'Ana lives in Collegetown'} \\ \text{'Ana lives in Fall Creek'} \\ \text{'Ana lives in Northwest'} \\ \text{...} \\ \text{'Fred lives in Collegetown'} \\ \text{'Fred lives in Fall Creek'} \\ \text{'Fred lives in Northwest'} \\ \text{...} \\ \text{...} \end{array} \right\}$

If the feature analysis with the T feature on the determiner is correct, and if we want to stick with the compositional architecture of alternative semantics, then it is necessary to define a focus semantic value for [many$_{\rm T}$], and to use it compostionally to generate an alternative set at the sentence level. (71) suggests a natural language model for this process: the alternatives are generated with disambiguated demonstrative determiners. If we assume that the phrase [$_{\rm DP}$that graduate student] has the individual type e, then this generates a set of individuals as the focus semantic value of [$_{\rm DP}$that graduate student].

(71) that graduate student lives ... (pointing at Ana)
that graduate student lives ... (pointing at Fred)
that graduate student lives ... (pointing at Sue)
...

The point of the demostrative gestures is that, as the gestures vary, [$_{\rm DP}$that graduate student] designates different grad students, and the entire set of grad students is generated. If the resulting set of individuals is the focus semantic value of (72), then focus semantic values can be defined recursively in the usual way, producing the set of propositions (70) as the focus semantic value of (68b).

(72) [$_{\rm DP}$many$_{\rm T}$[$_{\rm NP}$grad students]]

How can this procedure be recast formally? (73) is a schematic alternative semantics derivation for the focus semantic value of (72). [$_{\rm NP}$grad student] has no T/F marking, so its focus semantic value is the singleton set (73a) containing just the property denoted by [$_{\rm NP}$grad student]. (73b) is a schematic focus semantic value for [$_{\rm D}$many]$_{\rm T}$. It is the set of all d which satisfy the condition $\Phi(d)$. The focus semantic value (73c) for (72) is then generated as the image of the function-application operation acting on (73b) and (73a). This image set is (73c).[16].

(73)a. $\{\mathbf{gradstudent}\}$
b. $\{d|\Phi(d)\}$
c. $\{x|\exists d[\Phi(d) \wedge x = d(\mathbf{gradstudent})]\}$

Since we want (73c) to be a set of individuals, d should map a property (with extensional type et, or intensional type set) to an individual. So the extensional type of d is $(et)e$. In view of the heuristic example (71), each d should be chosen so that $d(\mathbf{gradstudent})$ is in the extension of **gradstudent**. In other words, d should be a choice function. Since we want $d(\mathbf{gradstudent})$ to assume all grad students as value as d is varied, no other constraint on d is needed, and the constraint $\Phi(d)$ should be understood as "d is a choice function," which I will write as $\mathbf{ch}(d)$. (73)c, which is the focus semantic value for (72), now becomes (74).

[16]See Rooth (1985) or Rooth (1996) for an explanation of this kind of derivation for focus semantic values.

(74) $\{x|\exists d[\mathbf{ch}(d) \wedge x = d(\mathbf{gradstudent})]\}$

The standard alternative semantics for the F feature implies that the focus semantic for the VP in (68b) consists of properties of the form 'live in y', where y is a place. When this is combined with (74) (using the image construction, as above), we obtain the set of propostions of the form 'x lives in y', where x is a grad student and y is a place. Since this corresponds to the multiple wh question meaning (70), this focus semantics is consistent with the representation (75), where the first question index restricted by focus interpretation (which is the index 1) is coindexed with the overt question.

(75) a. $[\text{Which grad students live where}]_1$
b. $[\text{Many}_{\text{T}}\text{live in Collegetown}_{\text{F}}]\sim 1, 2$

The application of choice functions in generating alternatives for determiners is similar to choice-function analyses of in-situ wh (Reinhart 1992, 1997). As illustrated in (76), in such analyses a choice function operates in an embedded position on the restriction of an in situ wh phrase. In a higher position, the choice function is existentially quantified in a complex of operators which define a set of propositions as the semantic value of the question.

(76) a. Which lady read which book?
b. $\{p|\exists f \exists g[\mathbf{ch}(f) \wedge \mathbf{ch}(g) \wedge \mathbf{true}(p) \wedge p = \hat{}\mathbf{read}(f(\mathbf{lady}), g(\mathbf{book}))]\}$

This in-situ wh representation uses a choice function to generate an individual alternative in the position of the wh phrase, as in the alternative semantics analysis. However, in the alternative semantics analysis, the choice function is just used locally to generate alternatives for the T-marked determiner, and is not bound higher up. Alternatives are propagated in the usual way by recursive alternative semantics.

The second technical problem in a representation such as (75) is to specify the semantic mechanisms which constrain the second question-variable (2 in (75b)). I suggest that this variable corresponds to a multiple wh question similar to (75a), but with an additional restriction in the wh phrase in the T-marked postion. (77a-d) are a couple of alternative phrasings.

(77) a. Where do the rest live?
b. Where to the other grad students live?
c. Where do the grad students who don't live in Collegetown live?
d. Which grad students who don't live in Collegetown live where?

I will derive the residual question compositionally by the choice function mechanism, but adding an additional restriction. (78a) is the focus semantic value for a topic marked determiner which we already saw. (78b) adds to this a restriction Q_i which is intersected with the argument of the choice function.

(78) a. $[\![\text{many}_{\text{T}}]\!]^{\text{f}} = \{d|\mathbf{ch}(d)\}$

b. $[\![\text{many}_{\text{T}}]\!]^{\text{t}} = \{f|\exists d[\mathbf{ch}(d) \wedge f = \lambda P[d(\lambda x[P(x) \wedge Q_i(x)])]]\}$

I will treat Q_i as a free variable, the value of which is supposed to be set by the pragmatics.[17] It can be constrained a bit by assuming that the focus interpretation operator adds a presupposition that the residual question is not answered (not even partially) by the overt answer.

(79) a. [Many$_{\text{T}}$grad students live in Collegetown$_{\text{F}}$]$\sim 1, 2$
b. Index 1: which grad students live where?
c. Index 2: which Q_1 grad students live where?
(with a presupposition that this question is not answered by a.)

6 Discussion

The proposal in Sections 4 and 5 has a specific part having to do with the focus semantics of T-marked determiners, and a general one having to do with a re-organization of the system of question variables constrained by focus interpretation. The chief design feature of the specific part is that the T-marked determiner does not show up in the focus semantic value of the answer. This corresponds to the fact that (80b) expresses the disjunction of the two atomic answers (80c) and (80d). Since the meaning of *one* expresses the disjunction of atomic answers, it should not figure in the answers themselves.

(80) a. Where do Anna and Julie live?
b. One$_{\text{T}}$ of them lives in Freeville.
c. Anna lives in Freeville.
d. Julie lives in Freeville.

According to the general proposal, instead of constraining a local and residual question, TF-interpretatation constrains a global question and a residual question.

Is it possible to adopt the first conclusion—that is, that there is a specicial interaction between quantification and the recursive semantics of T and F features—while not making the architectural change in the alternative semantics of T and F? I have proposed that (80) has the representation (81), where the first variable constrained by focus interpretation is coindexed with the overt question. This suggests using a parallel representation in a non-quantifiified example (82). That parallel representation is (83), where the first variable constrained by focus interpretation is the overt global question.

(81) [Where do Anna and Julie live]$_1$
[One$_{\text{T}}$ of them lives in Freeville]$\sim 1, 3$
(Where does the other one live)$_3$

(82) Where do Anna and Julie live?

[17] As an alternative, one could try to establish the paraphrases (78) in the semantics.

Anna$_{\mathrm{T}}$ lives in Freeville.

(83) [Where do Anna and Julie live]$_1$
[Julie$_{\mathrm{T}}$ lives in Freeville]$\sim 1, 3$
(Where does Anna live)$_3$

At this point the architecture of TF-interpretation has been changed, because the representation of (82) in the synthesized architecture of Rooth (1992) and Büring (1995) is (84), where focus interpretation constrains a variable for the local question about Julie, not the global question about Anna and Julie.

(84) [Where do Anna and Julie live]$_1$
(Where does Julie live)$_2$
[Julie$_{\mathrm{T}}$lives in Freeville]$\sim 2, 3$
(Where does Anna live)$_3$

Is there a theoretical option of hypothesizing representations like (81) for quantified examples, and representations like (84) for non-quantified ones? This move has the consequence that there is no systematic pragmatic interpretation for the variables constrained by focus interpretation. Whether this is bothersome depends on assumptions about the pragmatics of the question variables constrained by focus interpretation. Approaches such as Roberts (1996) and Büring (2003) state pragmatic axioms which describe specific interpretations for the question variables. In such a theory, trying to combine (81) with (84) would lead to a complicated and unsystematic pragmatics.

In the architecture of Rooth (1992), there is no requirement for a systematic pragmatics for the question variables. Rather, the pragmatic import TF interpretation is that a discourse representation where the question variables are around is to be constructed, without stipulating any particular role for them. In this architecture, it is possible to contemplate combining (81) with (84).

In closing, I would like to point out that the technical proposal of sections 4 and5 leaves some empirical ground uncovered. While I mentioned examples like (85) in criticizing Büring's analsys, I did not analyze them myself.

(85) The female$_{\mathrm{T}}$ faculty live in Spartan$_{\mathrm{T}}$.

I also did not talk about examples where a T-marked determiner is combined with an additional contrast in the restriction:

(86) Where are the female students housed?
Many$_{\mathrm{T}}$ female grad$_{\mathrm{T}}$ students live in Spartan.

I will have to leave the exploration of these data for another occasion.

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