Book review

Quantification, A. Szabolcsi. Cambridge University Press (2010). 264 pp., price: $36.04 ISBN: 0521715938

Over the last four decades, quantification phenomena have been central for semantic theory and propelled some of its most important developments. Szabolcsi's book, published in CUP's series *Research Surveys in Linguistics*, aims at providing a broad review of many current approaches to quantification in natural language. This relatively short book (250 pages) is written as a concise handbook for researchers and advanced students, not as a research monograph. Given this limitation, Szabolcsi has done a good job summarizing important research directions, pointing out their possible significance and clarifying many relations between them. Any theoretical linguist with some background in mathematical or philosophical logic will benefit from reading (parts of) this book and relevant works from its extensive bibliography. The book is a fine companion to Peters and Westerståhl's monograph *Quantifiers in Language and Logic* (Oxford University Press, 2006). The two books complement each other. While Peters and Westerståhl's book is a comprehensive and rigorous introduction to the logical theory of quantification in natural language, Szabolcsi's book is a more informal, but also more inclusive, survey of some of this theory's most important applications in linguistics.

The book focuses on three topics: the analysis of DPs as generalized quantifiers, problems of quantifier scope, and the internal semantics of DPs. Other central problems that are touched upon include collectivity and distributivity, event semantics, dependent plurals, the syntax/semantics of floating quantifiers, flexibility operators, domain restriction, raising constructions, implicatures, and cross-linguistic semantics of quantification. Naturally, this short review can only concentrate on some of these areas. Below I make some comments on the topics of generalized quantifiers and quantifier scope as they are reviewed in the book, and raise some questions regarding Szabolcsi's conception of what she calls the "existential scope" of universal DPs. At the end of this review I comment on the general organization and style of the book, and make some additional remarks on its packaging and usability.

Generalized quantifiers Dealing primarily with natural language, Szabolcsi starts out her review by introducing the standard treatment of DPs using generalized quantifiers. A *generalized quantifier* (GQ) is a function from sets of entities to truth-values. Isomorphically, a GQ is a set of sets of entities. Crucially, this introduction of GQs takes them to be the model-theoretic objects denoted by DPs. This is a difference from the quantifiers of the predicate calculus, which are symbols whose contribution to a formula's denotation is indirect. In Chapters 2, 4 and 5, Szabolcsi reviews central usages of GQ theory in natural language semantics, and discusses some of the many challenges for this theory. In terms of its contents, Szabolcsi's overview of basic GQ theory does not add much to available review articles like Keenan and Westerståhl (1996) and Keenan (1996, 2011). However, it pleasantly sets the background for the other parts of the book.

Quantifier 'scope' Chapter 2 also introduces the notion of quantifier scope that is dealt with in Chapters 6–8 and 11. In predicate logic, with its variable binding quantifiers, it is important to define the *scope* of a quantifier Q occurrence within a formula φ. The scope of Q is the part of φ adjacent to Q, in which variables are *bound* by Q. The definition of binding affects both the semantics and the use of axioms in the predicate calculus. Borrowing this terminology from formal logic, linguists often refer to the 'scope' of natural language expressions, even when they assume, like Szabolcsi, that these expressions are <u>not</u> analyzed as variable binding operators but are directly interpreted in the model. Concentrating on quantificational DPs, which are directly interpreted as GQs, Szabolcsi introduces her linguistic use of the term 'DP scope' as follows:

(1)   The *scope of a quantificational DP*, on a given analysis of the sentence, is that part of the sentence which denotes a property that is asserted to be an element of the generalized quantifier denoted by [the] DP on that analysis (Szabolcsi, p. 10)

Szabolcsi (p. 11) refers to this notion of DP scope as "semantic scope". Following Reinhart (1983), she distinguishes the scope of a DP from its *syntactic domain*. In the context of this book, I am afraid that Szabolcsi's presentation of this distinction is bound to confuse many readers. Szabolcsi's account of semantic scope in (1) relies on a given syntactic and semantic

analysis of the sentence. Let us call this analysis *A*. Some *syntactic* part of the sentence under the analysis *A* is defined as the scope of the quantifier denoted by the DP. With simple compositional assumptions, (1) entails that this scope must be the DP's sister, i.e. its syntactic domain in *A*. Introducing semantic scope and syntactic domains in this way makes Reinhart's thesis about their identity look trivial. Here I see three factors that make Szabolcsi's explanation more confusing than necessary:

- In Section 2.3.3, Szabolcsi explains that she does not address anaphor binding by quantifiers. However, when introducing Reinhart's hypothesis about scope we cannot ignore the fact that for Reinhart, 'syntactic domains' are not abstract artifacts of syntactic theory, but empirical objects observed in a DP's binding domain of anaphors. Reinhart made the debatable but non-trivial claim that in the syntax-semantics of natural language, as in predicate logic, the binding domain of quantifiers is identical to their scope over other quantifiers. By ignoring the binding domains, Szabolcsi's presentation makes Reinhart's empirical claim look like an innocent theoretical statement.
- The notion of ''semantic scope'' in (1) mixes a syntactic notion (scope) with semantic intuitions. The syntactic assumptions underlying the sentence analysis that is presupposed in (1) are not clarified. My impression is that it is would be easier to avoid confusions by describing pre-theoretical semantic intuitions about 'DP scope' directly in semantic terms of paraphrases, entailments, truth-in-situations etc., without relying implicitly on syntactic analyses.
- Szabolcsi starts her discussion directly with quantifier scope without discussing other, simpler, ambiguities. For instance, virtually all linguistic theories take the two possible syntactic scopes of the adjunct in sentences like *I read that UFOs landed in Arizona* to be the key element that accounts for the sentence's semantic ambiguity. Generalizing Szabolcsi's notion of ''semantic scope of DPs'' to such cases would be both straightforward and instructive. Without this general background perspective on ''structural'' theories of ''semantic scope'', it is hard to understand Szabolcsi's term ''non-structural theories of scope'' (p. 11) when applied to quantifier scope.

There is an additional problem that I see with the way Szabolcsi chooses to introduce the hard problem of quantifier scope. It concerns her extensive technical reviews in Sections 2.3.2–2.3.6 (pp. 12–32) of four scope mechanisms: quantifying-in, quantifier raising, type-shifting and continuations. The technical details that Szabolcsi surveys in these sections are not necessary for understanding the discussion in the rest of the book. At the same time, as a review of available scope techniques, this part of the book is not sufficiently exhaustive. Most lacking in my view is Szabolcsi's coverage of type-logical approaches to quantifier scope. This direction was proposed in Moortgat (1988) and van Benthem (1991). Recently it has been substantially developed in a series of works on *Abstract Categorial Grammar* (de Groote, 2001; Muskens, 2003, a.o.; see also introductions in de Groote and Salvati, 2009; Kanazawa and Pogodalla, 2009; Winter, 2010). ACG explicates scope phenomena as following form foundational assumptions about hypothetical reasoning and the use of linguistic signs (de Saussure, 1959). It is a pity that this approach is not covered or even mentioned in Szabolcsi's review. As shown in Barker and Shan (2006), type-logical grammar, and in particular ACG, is formally related to the continuation-based scope mechanisms (Barker, 2002) that Szabolcsi discusses extensively.

Szabolcsi claims (p. 12) that there is ''no deep semantic necessity'' to opt for one of the techniques she surveys. This general claim may be true, but it is made without too much technical argumentation. Without a more technical discussion, involving also the formal meta-principle of compositionality (Montague, 1970; Janssen, 1983 and further work), it is hard to be convinced that the four mechanisms that Szabolcsi reviews are nothing but notational variants of each other. However, since this point is important for Szabolcsi's discussion, I think that it would be more useful for the audience of her book if she could make it with respect to a larger part of the literature on standard scope mechanisms, but without getting into the intricate technical details of specific proposals.

These critical remarks mainly concern the introduction of quantifier scope in Chapter 2, and the survey of some mechanisms that describe it. However, I believe that a reader with some background on scope problematics can glance over these introductory sections and go directly to the more advanced sections and chapters later in the book. Chapters 6–11 address diverse scope phenomena with various DPs (existential, distributive, numerals, a.o.) in different constructions. In these parts the reader will find a good review of some of the hardest problems in this area with some of their treatments. Szabolcsi's discussion is in most cases brief and very informal, but this makes it possible for her to review remarkably many problems and approaches in a friendly and accessible style. These parts of the book are a valuable addition to the large literature on the syntax-semantics interface. They update and extend much of the work reported in Szabolcsi (1997), and are extremely useful for anyone interested in the vast and on-going work on quantifier scope.

Existential scope of universals? In Chapter 7 (''Existential scope vs. universal scope''), Szabolcsi argues for strong similarities between the scopal behavior of indefinite DPs like *some student* and *two students*, and universal DPs like *every student*. Especially, Szabolcsi claims (p. 102) that both indefinites and universals have the following two properties:

(a) ''Their existential scope is potentially unbounded, i.e. their 'reference' can be kept independent of any structurally higher operator in the sentence.''
(b) ''They can [also] be referentially dependent on a higher operator.''

Equating in (a) the notions of ''existential scope'' and ''referential dependency'', Szabolcsi argues that the same mechanism that accounts for the existential scope of indefinites should be used for determining the restrictions on quantifier domains. Consider the following example, which Szabolcsi attributes to Kuroda (1982).

(2)   Every child tasted every apple.

Szabolcsi paraphrases the ''referentially dependent'' use of the universal DP *every apple* in (2) as follows: every child has his/her own apples and tasted each of them. The formula below describes this intuition, where C is the set of children, and A is the set of apples.

(3) $\forall x \in C. \exists A' \subseteq A. \forall y \in A'.\mathbf{taste}(x, y)$

The existential quantification in formula (3) seems to paraphrase correctly the interpretation of sentence (2) in which the object's domain is ''dependent'' on the subject quantifier. Szabolcsi concludes (p. 103) that the literature may have consistently erred in overlooking what she calls ''the existential scope'' of universals as in (2). However, there are some significant differences between ''referential dependence'' of universals as in (2) and narrow existential scope of indefinites. Szabolcsi's arguments cannot fully support her harsh judgement without a convincing account of these differences. To see one of them, consider the following example.

(4)   Every girl in this class admires every boy in this class.

Sentence (4) does not easily show the kind of dependency that is observed in (2).[1] By contrast, the object indefinite in the following sentence easily gets narrow existential scope below the universal subject.

(5)   Every girl in this class admires a/some/two boy(s) in this class.

    Szabolcsi is right in pointing out that the ''dependency'' process in (2) is also likely to occur with indefinite DPs. Although the evidence are rather complex, this was part of the initial motivation for introducing Skolem functions into the interpretation of indefinites (Kratzer, 1998). However, as the contrast between (4) and (5) illustrates, Szabolcsi's approach, which tries to explain existential scope of indefinites in terms of domain restriction dependency, must clarify where the differences between the two processes come from.

    As another difference between the two processes, note that while existentials can take narrow scope below *any operator*, the domain restriction of universals seems to only vary with *anaphor binding* operators like *every child* in (2). As a classical example for an operator that does not bind anaphors, let us take negation. Suppose that John is a car dealer, and consider the following sentence.

(6)   John does not buy every car.

Sentence (6) is naturally interpreted as meaning that there are some car(s) that John does not buy. Szabolcsi's analysis expects that the universal in (6) should get ''narrow existential scope'' below the negation as in the following formula.

(7) $\neg [\exists C' \subseteq C. \forall x \in C'.\mathbf{buy}(j, x)]$

I do not see how sentence (6) could ever get the meaning paraphrased in (7). Unlike sentence (6), formula (7) becomes patently false if the set C' is allowed to be empty. If on the other hand we add the requirement that the set C' must contain at least two or three cars (as Szabolcsi does in her analysis of universals), then sentence (6) is analyzed in (7) as meaning that John doesn't buy more than two/three cars. This is also a very unlikely interpretation of the sentence.

    The discussion on p. 105 shows that Szabolcsi may be aware of these potential problems for her approach. Szabolcsi tentatively proposes that indefinites involve ''existential quantification over (individuals or) choice functions'', whereas with universals ''the context supplies the choice function (i.e. the domain restriction)''. This idea could perhaps be developed in order to address the concerns that were made above. However, Szabolcsi's introduction of her ideas in Section 7.2 is

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[1] The reasons that the object DPs in (2) and (4) are different in terms of their referential dependency on the subject does not need to concern us here. Plausibly, this is because of the occurrences of the prepositional modifiers *in this class*, which modify the restrictions of both universal DPs, and leave little room for further domain restrictions as observed in (2).

extremely short and informal, and does not rely on previously published material. I find it hard to evaluate these novel ideas. This part of Chapter 7 would be more convincing if it could be further developed into a separate work.

Some notes on formalization, organization and packaging Szabolcsi's decision to keep her discussion as informal as possible (p. 3) makes sense when it comes to describing intricate phenomena and reviewing on-going research, which is sometimes by necessity incomplete or hard to appreciate. In such cases, lack of formalization may sometimes contribute to readability. However, as the remarks above show, keeping the discussion informal (and at times tentative) may also lead to avoidable unclarities. This is especially infelicitous when dealing with formal notions, as in Szabolcsi's informal presentation of the *extension* property of determiners. Szabolcsi claims (p. 63):

> ''DET has extension if DET(NP')(Pred') remains true if the size of the universe outside changes.''

From this informal description it is impossible to reconstruct the proper definition of the *extension* property of determiners.[2] A correct description of the extension property, which is just as informal and readable as Szabolcsi's statement, would be:

> DET has extension if DET(NP')(Pred') has the same truth-value if the universe outside the sets NP' and Pred' changes.

I believe that at various points in Szabolcsi's book, the presentation could have been similarly improved and clarified. This might increase the value of Szabolcsi's summaries also for readers who are not particularly interested in formal semantic details.

Another point that distracted me a little as a reader was the organization of the chapters. The first part of Chapter 2 reviews essentials of GQ theory, which is nicely complemented in Chapter 4 by introducing some linguistically relevant properties of GQs. The second part of Chapter 2 deals with quantifier scope phenomena and mechanisms (see above). Chapter 3 contains some remarks on non-nominal quantifiers and raising verbs. The many topics discussed between the introductory part of Chapter 2 on GQs and Chapter 4 on properties of GQs are not necessary in order to follow Chapter 4, and are more relevant to the latter parts of the book.

Some small points on matters of packaging and formatting:

- As Szabolcsi remarks, the end-notes in her book are an integral part of the text. However, in our days of massive hyperlinking, putting important text in end-notes (rather than footnotes) is almost a sure recipe for having much of it ignored.
- Szabolcsi appropriates small caps for textbook or textbook-like references like 'GAMUT (1991)' or 'BARWISE AND COOPER (1981)'. However, the text is not very consistent on this convention, and such references often appear as 'Gamut (1991)' or 'Barwise and Cooper (1981)'.
- The use of 'NP' (the syntactic unit headed by a noun) in a different meaning than 'noun phrase' (a synonym of 'DP') is sometimes confusing.
- The book contains a subject index and a language index. However, the lack of an author index did not match my initial expectations when I read the publisher's blurb proclaiming a ''detailed index for ease of orientation''.

Overall The critical remarks above should not obscure my main impression as expressed in the introduction. Despite some local faults this is a timely book with many interesting analyses coming from wide empirical and theoretical perspectives. I recommend it highly to any researcher or advanced student of Linguistics who is interested to understand how ''quantification'' has almost become a synonym for ''natural language semantics''. Szabolcsi's vast knowledge is admirable. The bibliographic list in her book (almost 500 items!) is extremely useful. I wish that it does not take long before it becomes freely downloadable in some portable format (BiBTeX, Zotero, etc.). By consulting this list and Szabolcsi's useful summaries of many works in it, reading the book often gave me that unique happy-hungry feeling which stimulates research: ''how lucky I am to be working in this dynamic field; how many interesting challenges we still have to overcome!''.

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[2] A *local determiner* D_E over a non-empty set of entities E is a binary relation between subsets of E, or, isomorphically, a function from $\wp(E) \times \wp(E)$ to $\{0, 1\}$. A functor D is a *global determiner* if it maps every non-empty set of entities E to a local determiner D_E. We say that the global determiner D satisfies *extension* if for all non-empty domains of entities E and E' s.t. $E \subseteq E'$, for all sets A, $B \subseteq E$: the global determiner D satisfies $D_E(A)(B) = D_{E'}(A)(B)$.

Szabolcsi's statement therefore contains three inadequacies: (i) it does not specify which changes in the universe are considered ''outside'' (Szabolcsi means to say ''outside the sets NP' and Pred'''); (ii) it does not require that DET(NP')(Pred') also remains *false* if the universe outside the sets NP' and Pred' changes; (iii) it is not only the *size* of the universe outside the sets NP' and Pred' that doesn't matter: also the identity of elements in this part of the universe doesn't matter for determiners with the extension property.

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Yoad Winter
Utrecht University, Netherlands
E-mail address: y.winter@uu.nl