Propositions or Choice Functions: What do Quantifiers Quantify Over?[1]

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1 Introduction

Generalized quantifier theory takes it that quantified determiners quantify over individuals, i.e., quantified determiners are taken to express relations between sets of individuals, one of which is contributed by the nominal restriction, the other by the predicate. This very successful idea encounters a severe problem in cases of so-called split scope, where the quantified determiner and the noun restriction seem to be interpreted apart from each other, as shown in the German example in (1) (from Abels and Martí 2010, but similar examples abound in the literature):

(1) *German*

Zu dieser	Feier	musst	du	keine	Krawatte	anziehen
to this	party	must	you	no	tie	wear

'To this party you don't have to wear a tie'

The most prominent reading of this sentence has it that there is a lack of obligation to wear a tie to the party. This reading seemingly involves the negative component of the negative indefinite *kein(e)* 'no' taking scope above the universal modal, whereas the existential component takes low scope with respect to the modal, with the noun restriction, *Krawatte* 'tie', interpreted low. Because generalized quantifier theory treats quantifiers like *kein(e)* as unanalyzed units, it is not possible to interpret its negative and existential components apart from each other. Something in our approach to quantification, then, has to change if we are to account for split scope.[2]

There are different ways to do so. For example, Hackl (2001) proposes a treatment of comparative quantifiers, such as *fewer than n*, in which they are decomposed into two quantifiers over degrees, so that one of them can scope above, and the other below, the intensional verb. Penka (2007) proposes a treatment of negative indefinites in which they are actually (positive) existential quantifiers that agree with a (potentially silent) negative,

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[2] Split scope of quantifiers is quite common in languages like German or Dutch. Downward-entailing comparative quantifiers (see below and Hackl 2001) and *exactly*-numerals (see Abels and Martí 2010) also split their scope across intensional verbs in German. *Exactly*-numerals do so in English too, at least for some speakers (see Breheny 2008, Carston 1998, Geurts 2006; the readings of interest do not come out as split scope readings in the analyses proposed in these references).

propositional operator, an operator that is positioned above the intensional verb. Abels and Martí (2010), arguing that the split scope of both negative indefinites and comparative quantifiers is a unified phenomenon (see section 2.2.3 for a summary), propose, following Fox (1999, 2001, 2002) and Sauerland (1998, 2004), that natural language quantification is quantification over choice functions. Assuming the copy theory of movement and complementary deletion, the quantified DP first moves above the intensional verb. Then, one part of the quantified phrase is interpreted above it, and the other part below it. The issue that all of these proposals deal with is this: if different parts of the quantified noun phrase are interpreted in different positions, what is the syntax and semantics of the parts such that the resulting structure is interpretable and gives rise to the correct reading? Section 4 of this paper presents the choice function approach to quantification in greater detail.

There is an approach to quantification, namely, that developed in Kratzer (2005) and Kratzer and Shimoyama (2002), which, despite its similarities with Penka's approach, has not been shown to account for split scope. In this approach, to be presented in more detail in section 2, no quantified determiner carries quantificational force of its own. Instead, determiners agree with (potentially silent) propositional operators that are the true carriers of quantificational force. These operators operate on propositions and attach at different points in the clausal spine. Down below, the quantified noun phrase introduces Hamblin alternatives, which project up the tree and get "caught" by these operators.[3] This approach seems well equipped to deal with split scope—one of the points we make below is that it can indeed account for the split scope readings of negative indefinites and comparative quantifiers.[4]

Our aim in this article is to compare two approaches on the basis of how they fare with respect to split scope. One is Kratzer's and Kratzer and Shimoyama's; we call this approach the "propositional theory". The other is the one defended in Abels and Martí (2010), where quantified determiners quantify over choice functions. We call that the "choice function theory". The two theories differ in how they answer the question we posed above regarding the syntax and semantics of the "scattered" quantifier that we seem to need. In the propositional theory, the quantificational force is provided by a propositional, alternative-sensitive operator that is attached somewhere above the intensional verb. In the choice function theory, the quantificational force comes from the quantified determiner itself, a quantifier over choice functions that is interpreted above the intensional verb because it moves there. In the propositional theory, the noun restriction introduces Hamblin alternatives, and Hamblin Functional Application ensures that these alternatives keep "expanding" until they meet the propositional operator. In the choice function theory, the noun restriction is interpreted low and serves as the argument of a choice function.

We identify two design features of the propositional theory that we take issue with. First, as a result of a natural extension of the propositional theory, an extension that allows it to deal with split scope and which we develop in section 2.2, the propositional theory must allow what we call "disassociation". This refers to a situation in which the operator

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[3] This is the strong version of this proposal. There is a weaker, mixed version, where both propositional operators and generalized quantifiers co-exist; i.e., where *some* quantified determiners do carry quantificational force of their own. We find the stronger version of the proposal more interesting to engage with, so we don't address the weaker version in this article.

[4] This is in some ways a generalization of Heim's (1982)/Kamp's (1981) treatment of indefinites. Butler (2004) also argues that all quantification is propositional, though he doesn't use an alternative semantics to deal with the noun restriction of the quantified determiner. Beghelli and Stowell (1997) propose that quantified phrases move to special positions in the clausal spine for their interpretation. Penka (2007) also belongs to this family of approaches, though her claims apply to negative indefinites only.

that catches the alternatives introduced by a quantified determiner is distinct from the operator that that determiner agrees with. Once disassociation is allowed, however, certain problems of over-generation arise in the propositional theory, which we explore in section 3.1.

The second design feature is that scope does not entail movement in the propositional theory. Indeed, scope is determined in this theory by the operator that catches alternatives. We show in section 3.2 that the lack of movement as a crucial ingredient of scope makes it difficult for the propositional theory to predict which intensional verbs are capable of splitting the scope of quantificational determiners (and when), and which ones are not.

The over-generation problems we point out will be important in our comparison between the propositional theory and the choice function theory, which we undertake in section 4.2, because in the choice function theory, no additional stipulations need to be appealed to in order to avoid them. The problems raised by disassociation do not arise as a matter of principle in the choice function theory, since no disassociation is possible in it. In order to account for the two classes of verbs mentioned above, an independently justified division in the class of intensional verbs is appealed to by the choice function theory—this independently justified classification of verbs makes crucial use of the (im)possibility of movement out of infinitival complements, which sits naturally in an account of quantifier scope that makes crucial use of movement, and unnaturally in one that doesn't.

This is not to say, of course, that there is nothing the propositional theory can appeal to in order to stop over-generation. We will indeed discuss what the propositional theory can appeal to in order to prevent these problems. What's important to us here, though, is that there are problems that arise in this theory as a matter of principle—because of the way it is designed.

2 The propositional theory

2.1 Basics

In the propositional theory, natural language quantifiers are analyzed according to the following schema:

(2) [∃]/[Neg]/[Q]/[∀] .... QP .... e.g., [∀] .... every book ....

That is, the quantificational force associated with a quantified DP (QP in (2)) never actually comes from it; rather, the QP establishes a long-distance agreement relation with a propositional operator that is the true carrier of quantificational force.

It is quantification in Japanese that is usually adduced as the best empirical motivation for this approach. After all, Japanese makes widespread use of quantification at a distance, as illustrated in (3), and as widely discussed in the literature (see, e.g., Nishigauchi 1986, 1990, Ohno 1989, Shimoyama 2001, 2006, von Stechow 1996, Yatsushiro 2009):

(3) *Japanese*

a. [[<u>Dono</u> gakusei-ga syootaisita] sensei] -<u>mo</u> odotta
IND.PHRASE student-NOM invited teacher -MO danced
'For every student x, the teacher(s) that x had invited danced'

b. [Taro-wa [[<u>dare</u>-ga katta] mochi]-o tabemasita] <u>ka</u>?
Taro-TOP IND.PHRASE-NOM bought rice.cake-ACC ate Q
'Who is the x such that Taro ate rice cakes that x bought?'

(Kratzer and Shimoyama 2002)

Japanese makes use of so-called 'indeterminate phrases', that is, phrases whose quantificational force is not (necessarily) determined locally but in relation to a long-distance operator, underlined in (3). Thus, *dono gakusei*, an indeterminate phrase, is interpreted universally when the operator used is *–mo*, as in (3)a, but *dare* is interpreted as a question word when the operator *ka* is used, as in (3)b. Both *–mo* and *–ka* are separated from these indeterminate phrases in (3).[5]

Kratzer (2005) and Kratzer and Shimoyama (2002) propose that indeterminate phrases agree long-distance with these overt operators. Indeterminate phrases are indeterminate because they are unselective with respect to which operator they agree with:

(4) [∃]/[Neg]/[Q]/[∀] .... indeterminate phrase ....

In the semantics, indeterminate pronouns introduce Hamblin alternatives. Thus the denotation of *dare* is as in (5):

(5) $[[\textbf{dare}]]^{w,\,g} = \{x\text{: human }(x)(w)\}$

Non-alternative-inducing items have as their meaning the set containing their ordinary denotation as their only member. For example, for the verb 'sleep', we have:

(6) $[[\textbf{nemutta}]]^{w,g} = \{\lambda x \lambda w'.\ \text{slept}(x)(w')\}$

In order for these sets to be handled in a compositional manner by the semantics, rules of semantic composition are modified in this system. For example, Hamblin, or point-wise, Functional Application is as follows (from Kratzer 2005 and Kratzer and Shimoyama 2005):

(7) Hamblin Functional Application
If α is a branching node with daughters β and γ, and $[[\boldsymbol{\beta}]]^{w,g} \subseteq D_\sigma$ and $[[\boldsymbol{\gamma}]]^{w,g} \subseteq D_{<\sigma,\tau>}$, then $[[\boldsymbol{\alpha}]]^{w,g} = \{a \in D_\tau : \exists b \exists c\ [b \in [[\boldsymbol{\beta}]]^{w,g}\ \&\ c \in [[\boldsymbol{\gamma}]]^{w,g}\ \&\ a = c(b)]\}$

Hamblin Functional Application ensures that the alternatives introduced by indeterminate phrases expand up the tree. Applying this rule now to *dare nemutta*, we obtain the following:

[5] Kuroda (1965) lists the following as the set of indeterminate phrases in Japanese: *dare* 'who', *nani* 'what', *dore* 'which (one)', *dono* 'which', *doko* 'where', *itu* 'when', *naze* 'why', and *doo* 'how'. Of course, the translation as *wh*-words is appropriate only when in the company of *ka*.

(8) $[[\textbf{dare nemutta}]]^{w,g} = \{p{:}\exists x\ [\ human(x)(w)\ \&\ p = \lambda w'.\ slept(x)(w')]\}$

If John, Bill and Mary are the only relevant individuals, the above set comes out as follows: {that John slept, that Bill slept, that Mary slept}. This system is based on Rooth's (1985) alternative semantics for focus, except that, for Rooth, alternatives are not part of the ordinary semantics, but of a special focus semantics that is computed alongside the ordinary semantics.

The propositional operators that quantified determiners agree with are sensitive to alternatives. These operators take sets of propositional alternatives and return singleton sets of propositions, i.e., they stop alternatives from further expansion:

(9) For $[[\alpha]]^{w,g} \subseteq D_{<s,t>}$:
(i) $[[\exists\alpha]]^{w,g} = \{\lambda w' \exists p\ [p \in [[\alpha]]^{w,g}\ \&\ p(w')]\}$
(ii) $[[\forall\alpha]]^{w,g} = \{\lambda w' \forall p\ [p \in [[\alpha]]^{w,g} \rightarrow p(w')]\}$
(iii) $[[\textbf{Neg}\ \alpha]]^{w,g} = \{\lambda w' \neg\exists p\ [p \in [[\alpha]]^{w,g}\ \&\ p(w')]\}$

If an existential propositional operator were to operate on (8), we would obtain a set containing a single proposition, the set of worlds w' such that there is a proposition in the set in (8) that is true in w'. This would give existential force to the indeterminate phrase.[6] Thus, it is in this way that indeterminate phrases relate to the carriers of the quantificational force they themselves lack.

Arguments for this analysis are that intervention effects and *wh*-island sensitivity of Japanese indeterminate pronouns can be accounted for quite easily, while at the same time the fact that the relationship between them and their operators is not subject to Condition on Extraction Domain (CED) effects is also accounted for (see Shimoyama 2006). Intervening alternative-catching operators will prevent higher operators from catching alternatives and thus from "giving" their quantificational force to the indeterminates; this is how, e.g., *wh*-intervention is explained. At the same time, complex NPs or adjuncts do not prevent indeterminates from association with higher quantificational operators: that's because these syntactic islands do not introduce alternative-catching operators. This account of which potential islands are in fact islands for the scope of indeterminates is one of the selling points of the propositional theory. Also, the fact that one operator can be in a relationship with more than one indeterminate pronoun at the same time (unselective binding) is accounted for in the propositional theory. Of course, there may be reasons why these arguments for the propositional theory do not hold.[7] In this paper, however, we will be taking issue with the propositional theory on different grounds.

The propositional theory generalizes the Japanese strategy, so that all natural language quantifiers actually involve quantification at a distance, even if on the surface they don't seem to. One difference is that quantified determiners in other languages seem to be selective, i.e., they are not indeterminate and they choose which propositional operator they agree with. Thus, take the existential quantifier *etwas* 'something' in German:

[6] The attentive reader will have observed that *–mo* in (3)a is not attached to a proposition-denoting phrase. In fact, it is an important question whether it is possible to treat *–mo* as a quantifier over propositions. Footnote 15 in Kratzer (2005) suggests that there is the possibility that, actually, *-mo* is not quantificational, but a type-shifting operator, as suggested by Tancredi and Yamashima (2004) and Yamashina and Tancredi (2005). Yatsushiro (2009), however, treats *–mo* as a generalized quantifier.

[7] Heim (2010), for example, argues that an alternative-based approach to quantification is not necessary if certain syntactic assumptions about movement in Japanese are in place.

(10) *German*

Hans	hat	etwas	gekauft
Hans	has	something	bought

'Hans (has) bought something'

The analysis here is that *etwas* introduces Hamblin alternatives, just like indeterminate pronouns, but that it agrees with [∃]. Negative indefinites, such as that in (11), agree with [Neg]:

(11) *German*

Peter	hat	kein	Auto
Peter	has	no	car

'Peter has no car/Peter doesn't have a car'

Important here is the fact that, at least in some languages, certain morphological markers can be taken to be agreement markers. For example, it is possible to take the *k-* of *kein* as a marker of agreement with [Neg], and in fact is taken as such in approaches to negative indefinites in German (see Penka 2007 and references cited there). Truth-conditionally, there is no difference between this type of analysis and a more traditional one, but Kratzer (2005) and Kratzer and Shimoyama (2002) argue that there are certain pragmatic effects induced by epistemic/free choice indefinites like German *irgendein* that can be captured better in this framework. Alonso-Ovalle and Menéndez-Benito (2010) argue that the slightly different properties of another epistemic indefinite, Spanish *algún*, can be captured equally well (see also, among others, Alonso-Ovalle 2006, Menéndez-Benito 2010). These claims have been challenged in the literature (see, among others, Aloni and van Rooij 2007, Aloni and Port 2010, Lauer 2010), but, again, here we take issue with the propositional theory on different grounds.

2.2 Split scope in the propositional theory

2.2.1 Negative indefinite split scope

Let us consider negative indefinite split scope within the propositional theory. First, some examples:

(12) *German* (=(1))

Zu dieser	Feier	musst	du	keine	Krawatte	anziehen
to this	party	must	you	no	tie	wear

'To this party you don't have to wear a tie'

(13) *German*

Während	der	Untersuchung	können	keine	Chirurgen	im	Raum	sein
during	the	examination	can	no	surgeons	in.the	Room	be

'...it's not possible for surgeons to be in the room'

(14) *English*

The company need fire no employees

'The company doesn't need to fire employees' (Potts 2000)

Split scope readings of negative indefinites are truth-conditionally distinct from plain narrow and wide scope readings. For example, the split scope reading of (12) is about a lack of obligation to wear a tie, whereas the narrow scope reading is about an obligation *not* to wear a tie. The wide scope reading is perhaps pragmatically slightly odd, at least unless more context is provided, since it is concerned with *de re* ties. In (13), the split scope reading is about an obligation: the obligation that surgeons be absent during the examination. The narrow scope reading is about a possibility, the possibility that there be no surgeons in the room during the examination, and the wide scope reading is a *de re* reading about actual surgeons.[8]

In the propositional theory as originally developed by Kratzer (2005) and Kratzer and Shimoyama (2002), the operator that a quantified determiner agrees with is also the operator that catches the Hamblin alternatives it introduces. Nothing in the theory, however, forces the same operator to be both the agreeing and the alternative-catching operator.

Indeed, we claim that disassociating the two functions is necessary in order to derive split scope; if this possibility is not allowed, split scope readings are not generated. The propositional theory needs to say that negative indefinites agree with the operator [Neg] and introduce alternatives; [Neg] would be located above the intensional verb, e.g., *musst* 'must' in (12). Schematically:

(15) [Neg] ... [intensional verb+[∃] ... kein NP]

In the propositional approach, intensional verbs introduce ∃-closure of their nuclear scope with the operator [∃]. Hence, they introduce a potential alternative-catching operator. (16) shows how the combination of *must* with this operator is interpreted (English words used for convenience):

(16) For $[[\alpha]]^{w,g} \subseteq D_{<s,t>}$:
$[[\textbf{must+[}\exists\textbf{]}\ \boldsymbol{\alpha}]]^{w,g} = \{\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p \in [[\alpha]]^{w',g} \ \& \ p(w'')]\}$

The contribution of *kein Krawatte* 'no tie' is as in (17):

(17) $[[\textbf{no tie}]]^{w,g} = \{x: tie(x)(w)\}$

In the split scope reading, *must*+[∃] catches alternatives and [Neg] is only the agreeing operator that licenses the presence of *no tie*:

(18) [Neg] [must+[∃] [you wear kein tie]] =
[Neg] $\{\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p \in [[\textbf{you wear no tie}]]^{w',g} \ \& \ p(w'')]\}$ =
$\{\lambda w' \neg\exists p\ [p \in \{\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p \in [[\textbf{you wear no tie}]]^{w',g} \ \& \ p(w'')]\} \ \& \ p(w')]\}$

Must+[∃] stops the alternatives introduced by *no tie* from projecting further. This means that [Neg] operates on a singleton set, the set containing the proposition that, roughly, you

[8] See Penka (2007: 89-90) for an argument that negative indefinite split scope readings are indeed truth-conditionally distinct from other readings.

must wear a tie. The result of applying [Neg] to this set is the set containing the single proposition that it is false that you must wear a tie. This is the split scope reading.

Consider what happens, on the other hand, if disassociation is not allowed. In the derivation in (19), the operator [Neg] is both an alternative-catcher and an agreeing operator:

(19) [Neg] [must [you wear no tie]]

$$[\text{Neg}]\ ([[\textbf{must}]]^{w,g}([[\textbf{you wear no tie}]]^{w,g})) =$$

$$[\text{Neg}]\ (\{q: q=\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p\in[[\textbf{you wear no tie}]]^{w',g}\ \&\ p(w'')]]\}) =$$

$$\{\lambda w'\neg\exists r\ [r\in\{q:q=\lambda w'\forall w''[R(w'')(w''') \rightarrow \exists p[p\in[[\textbf{you wear no tie}]]^{w'',g}\ \&\ p(w''')]\}\ \&\ r(w'')]\}$$

There is no [∃] operator to catch alternatives at the site of the intensional verb,[9] so alternatives keep projecting up until they meet [Neg]. The set of alternatives that [Neg] operates on, let's call it A, contains propositions of, roughly, the form *that you must wear x, for x a tie*. [Neg] returns a singleton set of propositions, the one containing the proposition that no proposition in A is true. That is, (12) is predicted to mean something which is roughly equivalent to: 'it is false that you must wear tie 1, and it is false that you must wear tie 2, and it is false that you must wear 3, ...etc.'.[10] There is a scenario that makes this reading true but which is incompatible with the split scope reading. In this scenario, you wear a tie in every world, but in each world it is a different tie. Since the split scope reading is a lack of obligation reading, it is false in this case (the split scope reading is true as long as you wear a tie in some or no worlds).

Thus, disassociation is needed in the propositional theory in order to derive the split scope readings of negative indefinites.

2.2.2 Comparative quantifier split scope

As mentioned earlier, negative indefinites are not the only quantifiers that give rise to split scope. Hackl (2001) and Heim (2001) observe that comparative quantifiers like *weniger als n* 'fewer than n' also give rise to split scope (see also Abels and Martí 2010) (only non-upward-entailing quantifiers give rise to split scope; see section 4.2.1):

(20) *German*

Am	MIT muss man	weniger	als	drei	Bücher	veröffentlichen,
at.the	MIT must one	less	than	three	books	publish
um	fest	angestellt	zu	werden		
in.order	permanently	employed	to	be		

'At MIT one must publish fewer than three books in order to get tenure'

(21) *German*

Ich	habe	ihm	weniger	als	drei	Bücher	zu	schreiben	erlaubt
I	have	him	less	than	three	books	to	write	allowed

'I allowed him to write fewer than three books'

[9] It is not completely clear to us whether Kratzer (2005) and Kratzer and Shimoyama (2002) assume that there is a non-alternative catching *must* in addition to the alternative-catching one in (16). We entertain that possibility here for the sake of completeness.

[10] This is probably not a possible reading of the sentence, but we leave this matter aside.

The most prominent reading of (20) can be paraphrased as: ‘at MIT one must publish at least n books in order to get tenure, and n is less than three’. This is actually a split scope reading in Hackl’s account and in Abels and Martí’s (even if this is not obvious from the paraphrase). The plain wide and narrow scope readings are unavailable for pragmatic reasons. The wide scope reading is a *de re* reading about books—a very odd reading. The narrow scope reading is too strong; it says that in order to get tenure at MIT, you must publish the following number books, and only those: less than three. If you publish more, you don’t get tenure.

Example (21) illustrates comparative quantifier split scope across an existential intensional verb, *erlauben* ‘allow’. This reading can be paraphrased as follows: ‘this is what I allowed him to do: write a maximum of n books, n being less than three’. Again, the wide scope reading is odd because it is about *de re* readings. The narrow scope reading is very weak—it says that if he is to comply with what I allow, then there is a possible world in which he writes fewer than three books, without ruling out worlds in which he writes more than n books, for n less than three.

In order to account for the split scope of comparative quantifiers, the propositional theory can say that *weniger als n* agrees with [Neg], and that *weniger als drei* introduces alternatives consisting of pluralities of three or more parts/individuals:

(22) $[[\textbf{fewer than three books}]]^{w,g}$ = {x: x is a plurality of three or more and books(x)(w)}

With disassociation, we obtain the following:

(23) [Neg] [must+[∃] [one publishes fewer than three books]] =
[Neg] $\{\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p\in[[\textbf{one publishes fewer than three books}]]^{w',g}$ $\& \; p(w'')]\}$ =
$\{\lambda w'\neg\exists p\; [p\in\{\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p\in[[\textbf{one publishes fewer than three books}]]^{w',g} \& \; p(w'')]\} \; \& \; p(w')]\}$

[Neg] operates on a singleton set of propositions, containing the proposition that can be roughly characterized as: ‘that one must publish a collection of three or more books (in order to get tenure at MIT)’. [Neg] then gives us another singleton set of propositions, namely, the one that contains the proposition that it is false that one must publish a collection of three or more books. So, the requirement is not that one publishes three or more books. This, together with the assumption that one must publish at least one book[11], results in the split scope reading that the requirement is that one publishes at least n books, n being less than three.

Without disassociation, that is, if [Neg] was both the agreeing and the alternative catcher, we would not obtain a split scope reading:

[11] Notice that this assumption is independent of the particular account one favors. This is so because zero counts as less than three, but a sentence like (20), or like ‘John published less than three books’ are typically not true in a scenario in which no books were published. We think that this assumption could be a presupposition, but we will not be concerned here with its nature, since we don’t think it matters for the argument we’re developing in this paper.

(24) [Neg] [must [one publishes fewer than three books]] =
[Neg] $\{q: q=\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p\in[[$**one publishes fewer than three books**$]]^{w',g}$ & $p(w'')]\}$ =
$\{\lambda w'''\neg\exists p\ [p\in\{q: q=\lambda w'\forall w''[R(w')(w'') \rightarrow \exists p[p\in[[$**one publishes fewer than three books**$]]^{w',g}$ & $p(w'')]\}$ & $p(w''')]\}$

[Neg] operates on a set of propositions that contains propositions of the form *that one must publish x, for x a plurality of three or more books*. It is no longer a singleton set of propositions. [Neg] makes each of these propositions false. So the sentence is predicted to have a reading that entails that it is false that one must publish a plurality A of three or more books, that one must publish a plurality B of three or more books, and so on for other pluralities of three or more books. Notice that this is not necessarily a *de re* reading; the collections can be identified intensionally, e.g., *the author's first three monographs*, *the author's five most influencial books*, etc. Notice also that this reading is compatible with a scenario in which it is a requirement at MIT to publish three or more books, as long as they are not the same books—what doesn't happen is that one publishes collection of books A in all worlds, or collection of books B in all worlds. The split scope reading is not compatible with this scenario.

In order to account for the upper-bounded, split scope reading of (21) we proceed in the same way. First, we maintain the same assumptions as above, namely, (22), and the idea that *weniger als n* 'less than n' agrees with [Neg]. We assume the lexical entry for *allow* in (25); this is maximally similar to that in (16) for *must*:[12]

(25) For $[[\alpha]]^{w,g} \subseteq D_{<s,t>}$:
$[[$**allow+[∃] α**$]]^{w,g} = \{\lambda w'\exists w''\exists p\ [R(w')(w'')$ & $p\in[[\alpha]]^{w',g}$ & $p(w'')]\}$

Then, we do disassociation:

(26) [Neg] [allow+[∃] [he writes less than three books]] =
[Neg] $\{\lambda w'\exists w''\exists p[R(w')(w'')$ & $p\in[[$**he writes less than three books**$]]^{w',g}$ & $p(w'')]\}$ =
$\{\lambda w'''\neg\exists p\ [p\in\{\lambda w'\exists w''\exists p\ [R(w')(w'')$ & $p\in[[$**he writes less than three books**$]]^{w',g}$ & $p(w'')]\}$ & $p(w''')]\}$

[Neg] operates on a singleton set of propositions, namely, on the proposition that there is a world compatible with what I allowed him to do in which he writes a plurality of three or more books. [Neg] negates this proposition; thus, the sentence is predicted to entail that there is no world compatible with what I allowed him to do in which he writes a plurality of three or more books. I.e., I didn't allow him to write three or more books. This, together with the assumption, introduced earlier, that I allowed him to write at least one book, results in the split scope, upper-bounded reading of (21).

Without disassociation, again, we do not obtain a split scope reading, but we leave this final step of the reasoning to the reader.

[12] For the sake of perspicuity, we're ignoring here the fact that *erlauben* 'allow' in our examples takes an extra argument (i.e., the person who allows)—the accessibility relation R depends partly on this argument. This issue is irrelevant to the matter at hand.

2.2.3 Arguments for a unified account of negative indefinite and comparative quantifier split scope

In the last section we saw that the propositional theory can treat split scope of comparative quantifiers and negative indefinites in a unified way. Most approaches to split scope, e.g., Penka's (2007), explicitly treat the two separately, but Abels and Martí (2010) have argued that this is empirically mistaken. We repeat the main arguments here. In our view, the ability of a theory to deal with the split scope of negative indefinites and comparative quantifiers in a unified way is a test of its empirical adequacy.

The argument developed in Abels and Martí (2010) is that the split scope readings of the two types of quantifiers are restricted in the same way; thus, the null hypothesis is that is that they have a common origin. The first restriction they have in common is that both types of quantifiers allow split scope across (at least some) intensional verbs, but not across other scope-bearing items, like DP quantifiers or quantificational adverbs. Consider the following examples:

(27) *German*
Genau ein Arzt hat kein Auto
exactly one doctor has no car
'Exactly one doctor has no car'
*'There isn't exactly one doctor who has a car'

(28) *German*
Hans hat immer kein Geld
'Hans always has no money'
*'Hans doesn't always have money'

Negative indefinites in German do not split their scope across quantifiers like *genau ein Artz* 'exactly one doctor'—the sentence in (27) does not mean that there isn't exactly one doctor who has a car, for that may be true in situations that make the sentence false: e.g., in the situation in which, out of four doctors, two have a car and two don't. Likewise, (28) does not have a reading in which Hans doesn't always have money. This is true in a situation in which he has money sometimes, but this makes the sentence false.[13]

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[13] A potential issue with this argument is that at least some German dialects allow the split scope of negative indefinites across quantificational DPs under the so-called 'hat' contour, as illustrated in (i):

(i) *Some German dialects*
/JEDER Arzt hat KEIN\ Auto
every doctor has no car
'Not every doctor has a car'

This would seem to pose a problem for the claim that negative indefinite split scope patterns together with comparative quantifier split scope, since this is not something that comparative quantifiers can do. However, Abels and Martí (2010) argue that split scope under the 'hat' contour must be kept separate from other split scopes. First of all, there is a dialect split, so that all German speakers allow split scope across the relevant intensional verbs, but only certain dialects allow (i). Second, there is also a cross-linguistic split, so that if a language allows split scope, it allows it across intensional verbs, but not necessarily across universal quantifiers, as shown in (ii) for English (cf. Norwegian; Svenonious 2002: 125):

Comparative quantifiers behave the same way: they don't allow split scope across quantificational DPs like *jeder Professor* 'every professor' ((29)) or adverbs of quantification like *immer* ' always' ((30)):

(29) *German*

Jeder Professor	hat weniger	als	drei	Bücher	geschrieben
every professor	has less	than	three	books	written

'Every professor wrote less than three books'
*'Not every professor wrote 3 or more books'

(30) *German*

Hans	hat	immer	weniger	als	€300	auf	seinem	Bankkonto
Hans	has	always	less	than	€300	on	his	bank.account

'Hans always has less than €300 in his bank account'
*'Hans doesn't always have €300 or more in his bank account'

It was Kennedy (1997) who first observed a similar restriction on the scope of degree expressions like *less tall*. Kennedy's generalization, then, extends beyond these degree expressions and encompasses comparative quantifiers and negative indefinites.

The second restriction that operates on both negative indefinites and comparative quantifiers is that the intensional verbs that can and cannot split negative indefinites are the same as those that can and cannot split comparative quantifiers. We have seen above that *müssen* 'must' can split the scope of both above; other verbs in this class are *können* 'can', *brauchen* 'need', *anfangen* 'begin', *erlauben* 'allow', and *wagen* 'dare'. Verbs like *bedauern* 'regret', *beschließen* 'decide', *aufgeben* 'give up', or *sich weigern* 'refuse' cannot split the scope of either negative indefinites or comparative quantifiers. (31)-(32) show that both can split their scope across *erlauben* 'allow' (the latter repeats (21)), and (33)-(34) show that neither can do it across *bedauern* 'regret':

(31) *German*

Ich	habe	ihm	keine	Bücher	zu	schreiben	erlaubt
I	have	him	no	book	to	write	allowed

'I didn't allow him to write books'

(ii) *English*
a. The company need fire no employees (= (14))
'It is not the case that the company is obligated to fire employees'
b. All doctors have no car
*'Not every doctor has a car' (independently of intonation)

Also, split scope across universal quantifiers always requires the 'hat' contour, but split scope across intensional verbs does not require it, not even in the dialects that allow (i). Finally, it seems premature to draw conclusions on the basis of this type of split scope, as we know very little about it. E.g., we don't know if it's just universal quantifiers that can split scope, which dialects are the ones that can and can't do it, etc.

In any case, choice function quantification, the theory we will be comparing the propositional theory with, also treats negative indefinite and comparative quantifier split scope as a unified phenomenon, so this is not something we can use to tease apart the two theories.

(32) *German*
Ich habe ihm weniger als drei Bücher zu schreiben erlaubt
I have him less than three books to write allowed
'This is what I allowed him to do: write a maximum of n books, n less than three'

(33) *German*
…weil er kein Buch geschrieben zu haben bedauert
…because he no book written to have regrets
'...because he regrets not having written a(ny) book'
*'...because he doesn't regret having written a book'

(34) *German*
…weil er weniger als drei Bücher geschrieben zu haben bedauert
…because he less than three books written to have regrets
'...because he regrets having written less than three books'
*'...because he doesn't regret having written 3 or more books'

Finally, the split scope of both negative indefinites and comparative quantifiers disappears under extraposition; that is, when the infinitival clause containing the quantifier is extraposed. Example (35) lacks the split scope reading of the negative indefinite present in (31). Similarly, (36) lacks the split scope reading of the comparative quantifier present in (32):

(35) *German*
Ich habe ihm erlaubt [keine Bücher zu schreiben]
I have him allowed no books to write
'I allowed him to write no books (at all)'
*'I didn't allow him to write books'

(36) *German*
Ich habe ihm erlaubt [weniger als drei Bücher zu schreiben]
I have him allowed less than three books to write
'I allowed him to write n books, and n is less than three'
*'This is what I allowed him to do: write a maximum of n books, n being less than three'

Thus, the ability of the propositional theory to treat the split scope of negative indefinites and of comparative quantifiers in the same way speaks, in our view, in favor of that approach. It certainly does not furnish an argument against it. We believe, however, that the propositional theory does have trouble accounting for at least some of the restrictions we've observed in this section—particularly the second one, which we discuss in section 3.2 below.

3 Split scope and the problems it raises for the propositional theory

The two arguments we develop in this section are over-generation arguments: the propositional theory predicts certain readings to exist where in fact they do not. This contributes to the main argument of this article. In section 4 we will see that the choice function theory, because of the way it is designed, doesn't encounter these over-generation problems and is therefore to be preferred.

3.1 Disassociation

The fact that the propositional theory must allow disassociation in order to generate split scope readings of negative indefinites and comparative quantifiers leads to the expectation that split scope readings should be available in instances in which they actually aren't.

To solve this problem, the propositional theory would have to be enriched with an independent theory of locality—this would be a theory that constrains agreement relations in the appropriate way. In our view, this considerably diminishes the initial appeal of the propositional theory. Recall that one of the selling points of the theory is its ability to derive locality effects that obtain with Japanese indeterminate phrases. Furthermore, we think it is unlikely that a principled set of restrictions on agreement can be found that accounts for the facts we discuss below.

Let us begin the presentation of the over-generation argument by noting that the propositional theory predicts the quantifier *jeder* 'every' to give rise to split scope. Consider the following sentence (the problem arises also with existential intensional verbs as the verb doing the splitting, but we don't show that here):

(37)	Du	musst	jedes	Buch	kaufen
	you	must	every	book	buy
	'You must buy every book'				

According to (37), there is an obligation to buy every book. You don't comply with the regulations if, out of 30 books, you buy one. But the propositional theory predicts this sentence to have a reading in which the regulations are satisfied as long as you buy just one book, even if there are many contextually relevant books.

Recall that in order to generate split scope readings for negative indefinites and comparative quantifiers (section 2.2), it must be possible for an alternative-inducing item to agree with an operator that is distinct from the operator that manipulates, or catches, those alternatives. The configuration is schematized in (38) (the arrow indicates agreement):

(38) $[OP_1]$ ... $[OP_2]$ ... QP ...

$[OP_2]$ is the alternative-catching operator, since it is the first operator that occurs as the alternatives expand up the tree. This configuration is what we have called disassociation.

To see the problem with (37), consider the following two structures:

(39) [must+[∃] [[∀] [you buy every book]]
(40) [∀][must+[∃] [you buy every book]]

Structure (39) gives rise to the attested reading that there is an obligation to buy every book. Structure (40), however, a token of the schema in (38), is problematic. According to the propositional theory, then, *jeder* 'every' would not contribute universal force just by itself; instead, its function is to signal agreement with [∀], the true carrier of universal force. In addition, *jedes Buch* 'every book' introduces a set of alternatives, as in (41):

(41) $[[\textbf{every book}]]^{w,g} = \{x: atom(x) \& book(x)(w)\}$

With disassociation, and (41), we obtain the following:

(42) [∀] [must+[∃] [you buy every book]] =
[∀]{λw'∀w''[R(w')(w'') → ∃p[p∈[[**you buy every book**]]$^{w',g}$ & p(w'')]} =
[∀]{λw'∀w''[R(w')(w'') → ∃p[p∈{that you buy book A in w', that you buy book B in w', that buy book C in w',...} & p(w'')]} =
{λw'''∀p [p∈{λw'∀w''[R(w')(w'') → ∃p[p∈{that you buy book A in w', that you buy book B in w', that buy book C in w',...} & p(w'')]} → p(w''')]}

In this derivation, [∀] operates on a singleton set of propositions—the alternatives introduced by *every book* are already caught by [∃], which is introduced with the intensional verb. I.e., we obtain that all propositions in the following set are true: the set containing the proposition that, in each accessible world, there is a book that you buy. So it is true that in each accessible world, there is a book that you buy. This requirement, appropriately paraphrased by *you must buy some book* is met if you buy a book in every accessible world. The sentence does not have this reading.[14]

The basic problem that the propositional theory encounters with this type of derivation is that, because the alternatives introduced by *every book* are caught by a different operator, the universal force of [∀] is trivialized.

In order to prevent this problem, the propositional theory might appeal to the idea that the operator [∀] cannot take singleton sets as arguments. This would stop all derivations in which a distinct alternative-catching operator is in the scope of [∀]. There are indeed reasons for postulating such a constraint in the semantics of [∀]. Sauerland (2008) has argued that *every* imposes a so-called 'implicated presupposition' in the form of an anti-uniqueness requirement on its sister (he argues for an anti-duality implicated presupposition for *every* too, but this is not relevant to the matter at hand). Consider the following example:

(43) #Every nose of Kai's is runny

In Sauerland's analysis, example (43) has the implicated presupposition that Kai has more than one nose. That's because *every*, at least in English, forms part of a scale with the definite article, *the*. With (43), the speaker chose <u>not</u> to use *the*, which presupposes uniqueness. Thus, that must be because Kai has more than one nose, which is not

[14] In (41), we assumed that *book* denotes a set of atomic individuals. Doing otherwise does not affect our argument. Consider for example the following alternative denotation for *every book*, and the result in (ii):

(i) $[[\textbf{every book}]]^{w,g} = \{x: book(x)(w)\}$
(ii) [∀] [must+[∃] you buy every book] =
[∀]{λw'∀w''[R(w')(w'') → ∃p[p∈[[**you buy every book**]]$^{w',g}$ & p(w'')]} =
[∀]{λw'∀w''[R(w')(w'') → ∃p[p∈{that you buy book A in w', that you buy book B in w', that buy books A+B in w',...} & p(w'')]} =
{λw'''∀p [p∈{λw'∀w''[R(w')(w'') → ∃p[p∈{that you buy book A in w', that you buy book B in w', that buy books A+B in w',...} & p(w'')]} → p(w''')]}

The only difference with (42) is that *every book* now introduces alternatives that can be either atoms or plural individuals. What we obtain is that the sentence in (37) is true if you buy a book or books in every accessible possible world. This is, again, not a reading the sentence has.

compatible with world knowledge—that's what makes the sentence odd. Sauerland defends the existence of this new type of presupposition (different from non-implicated, conventional presuppositions, and from scalar implicatures) in other empirical areas.

While we grant that the propositional theory can appeal to an anti-singleton constraint for *every* to solve the problem in (37), it might be necessary for the propositional theory to stipulate this constraint. That's because it's not obvious that *every* and *the* are part of the same scale—presumably they are not of the same semantic type in this theory.[15]

Even if the propositional theory can independently justify this type of constraint for *every*, however, the problem of over-generation remains. The choice of quantifier in the discussion so far was essentially arbitrary. Therefore, even if the problems surrounding (37) can be solved using assumptions particular to *every*, other clause-level operators give rise to the same difficulties.[16] Consider a configuration in which [OP$_1$] = [Q]:

(44) [Q] ... [OP$_2$] ... *wh* ...

There are, in fact, questions in which the reading that (44) gives rise to is not attested. We need to use a more complex type of example than is schematized in (44), however, at least if we look at languages like German, since German is not a *wh-in-situ* language.[17] Consider (45) and (46):

(45) *German*
Wer hat welches Buch gekauft?
Who.NOM has which.ACC book bought
'Who bought which book?'

(46) *German*
Wer muss welches Buch kaufen?
Who.NOM must which.ACC book buy
'Who must buy which book?'

The analysis of example (45) within the propositional theory has one [Q]-operator agreeing with two *wh*-phrases, *wer* 'who' and *welches* 'which'. [Q] is the only operator in this example, so it also catches the alternatives introduced by the *wh*-phrases. This means that, in (46), a [Q] operator sitting at the top of the clause can in principle agree with both *wer* and *welches*. Turning now to (46), the problem is that it does not mean 'who must buy some book?', but exactly this reading is predicted to exist for this sentence if disassociation

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[15] Fox and Katzir's (2011) work on what counts as a possible alternative might be relevant here.
[16] The problem with universal quantifiers does not disappear anyway, as the following sentence with two universals shows:

(i) Everybody must buy every book.
(ii) [∀] [everybody [must+[∃] buy every book]]

The propositional theory allows more than one quantified determiner to agree with a single propositional operator. Thus, (ii) is allowed. The universal in (i)/(ii) obviously escapes trivialization, and the reading that everybody must buy some book still needs to be ruled out.
[17] Japanese would obviously be a good language to look at in this respect, but we leave that to the experts on that language.

is allowed. That is, this unattested reading is a split scope reading. The alternatives introduced by *welches* expand up the tree until they are caught by *must*+[∃]. Because the alternative catcher in this case is [∃], *whelches* will be interpreted indefinitely. The second *wh*-phrase, *wer*, introduces alternatives too. This means that [Q] operates on a set of propositions of the form *that x must buy a book*. The question would then ask which of these propositions is true. This is not something that (46) can ask.[18, 19]

How to address this problem is unclear. On the one hand, the propositional theory would have to say that intensional verbs sometimes disrupt agreement relations (e.g., in (46)). In other structures the very same verbs don't do so (otherwise, split scope readings for negative indefinites and comparative quantifiers are not generated). We don't know what independent properties of the different operators involved could be responsible for this distinction. This worry is at the heart of our claim that a principled theory of the syntactic locality of agreement does not seem to be forthcoming that could be coupled with the propositional theory.

The configuration involved in (46) is given in (47). This configuration is reminiscent of that involved in so-called Beck or intervention effects (after Beck 1996; see also Beck 2006):

(47) [[Q] ... *wh* [[OP$_2$] ... *wh* ...]]

It turns out that once disassociation is allowed, over-generation problems arise with Beck effects as well. These effects are important because Kratzer (2005) and Krazter and Shimoyama (2002) argue that one argument in favor of their theory is that it can provide a natural account of these intervention effects. (48) illustrates a typical Beck effect:

(48) *German* (Beck 1996)

a. *Wer	hat	nicht	wen	gesehen?
IND.PHRASE	has	not	IND.PHRASE	seen

b. Wer hat wen nicht gesehen?
'Who didn't see who?'

Japanese, whose intervention effects were briefly mentioned in section 2.1, is a *wh in-situ* language. German by contrast moves a single *wh*-phrase to its scope position in *wh*-questions. Therefore, in order to see intervention effects in German, we need to use multiple *wh*-questions again. When the *in-situ wh*-phrase follows negation, as shown in (48)a, the question is ungrammatical, but when it precedes negation, as in (48)b, it is grammatical.

Kratzer (2005) and Krazter and Shimoyama (2002) argue that this can be understood within the propositional theory. In (48)a, a [Q] operator sits at the top of the clause. It agrees with *wer*, but the agreement relationship with *wen* is disrupted by [Neg]

[18] The question is grammatical with the interpretation 'which x and which y are such that x must buy y?'. Presumably, this reading is generated by allowing intensional verbs like *must* to lack the [∃]-operator, or by scrambling the object *wh*-phrase past the intensional verb.

[19] We do not develop here a proper question semantics that can account for the range of meanings multiple *wh*-questions give rise to; e.g., we will not consider pair-list vs. single-pair readings. Whatever is necessary in the propositional theory to address these issues, the basic point still remains that the question in (46) cannot mean 'who must buy something?'.

(i.e., *nicht*). In (48)b, on the other hand, *nicht*/[Neg] does not interfere in this agreement relation. This difference is intended to account for the difference in grammaticality status we see in (48).

There are at least two problems with this analysis. First, the analysis by itself doesn't actually predict that (48)a is ungrammatical. *Wh*-phrases in German can be indefinite, so one might expect that *wen* could be interpreted as an indefinite here and agree with negation (or an abstract [∃] below negation). Such structures would give rise to the reading 'who didn't see anybody?'. An additional assumption preventing this needs to be invoked.

In the context of the present discussion of disassociation, there is a more pressing problem, however, since 'who didn't see anybody?' is also generated as the split scope reading of the sentence. On the split scope analysis, *nicht* would catch the alternatives introduced by *wen* while *wen* agrees with [Q]. To prevent this, [Neg] must interfere with agreement. This raises the question again of just which operators interfere with agreement and which ones don't—and why. Earlier we saw that, sometimes, must+[∃] interferes and sometimes it doesn't. Now we see that [Neg] must interfere. If the answer is that agreement with [Q] is more delicate than agreement with other operators, why is that?[20]

Finally, let's discuss Kennedy's generalization, which we alluded to in section 2.2.3. The propositional theory, because of how it is designed, must implement this generalization syntactically, not semantically, as we will now see. Discussing this generalization allows us to show, again, that the propositional theory must make arbitrary decisions as to which operators interfere with agreement and which ones don't.

Recall that neither comparative quantifiers nor negative indefinites can have their scope split by anything other than intensional verbs: other quantificational DPs, or quantificational adverbs, are not possible scope splitters. Let's look at example (27), repeated as (49):

(49) *German* (=(27))
Genau ein Arzt hat kein Auto
exactly one doctor has no car
'Exactly one doctor has no car'
*'There isn't exactly one doctor who has a car'

To account for such examples, the propositional theory must say that the <u>agreement relation</u> between a quantificational determiner and an operator cannot occur across (certain) intervening operators.[21] The propositional theory, then, must assume that an example like (49) lacks the split reading of the negative indefinite because the agreement relationship

[20] Tomioka (2007) asks a similar question to ours. We don't see, though, how his topicality-based account of Beck-style intervention effects could account for the seemingly variable behavior of must+[∃]. His account relies on identifying interveners with expressions that cannot be topics. That may work for those cases where must+[∃] intervenes, such as (46), but it is then a mystery why it doesn't also intervene in cases of split scope. A similar problem would seem to arise with Beck's (2006) analysis of intervention effects on the basis of focus. The problem with the propositional theory, however, may be even more severe, since, as we're trying to show here, the propositional theory must sometimes allow must+[∃] not to be an intervener in order to generate split scope readings. Pending an analysis of split scope in the framework of Tomioka's or Beck's accounts, we don't pursue the comparison further.

[21] In order to prevent the generation of a split scope reading in (49), the propositional theory cannot say that the <u>scope</u> of QPs cannot be split by quantificational DPs. Notice that the scope of the negative indefinite in (49) is determined at the level of the lowest operator—since that is the operator that catches alternatives. There is no sense in which the scope of, say, the negative indefinite *kein Auto* 'no car' is <u>split</u> by anything.

between this indefinite and [Neg], which would sit above *genau ein Artz* 'exactly one doctor', is broken by the operator that the QP *genau ein* 'exactly one' agrees with (whichever that might be; we call it [∃!] but remain agnostic about its meaning under this theory):

(50) [Neg] ... [∃!] ... exactly one doctor ... no car

Kennedy's generalization becomes part of the class of intervention effects discussed above, but, as also discussed above, a semantic account of intervention effects is unavailable if disassociation is assumed. As a result, intervention effects fall under the purview of a syntactic theory of agreement, a theory that has not been worked out and the prospects for which are not too promising, we believe.

Further examples can easily be constructed that make similar points. For example, notice that in order to block the unattested split scope reading of an example like (51), the propositional theory must say that it is propositional operators that intervene, not QPs/adverbs of quantification. In (51), no QP/adverb of quantification interferes in the relationship between [Neg] and *no student*, and yet, the derivation in (52) must be ruled out:

(51) No student bought every book

(52) [Neg] [[∀] [no student bought every book]]

$\rightarrow$ [Neg] [[∀] $\{p\text{: } \exists x \exists y\ x\ x \in [[\textbf{no student}]]^{w,g}\ \&\ y \in [[\textbf{every book}]]^{w,g}\ \&\ p = \lambda w'.x \text{ bought } y \text{ in } w'\}$]

[Neg] $\{\lambda w'' \forall q\ [q \in \{p\text{: } \exists x \exists y\ x\ x \in [[\textbf{no student}]]^{w,g}\ \&\ y \in [[\textbf{every book}]]^{w,g}\ \&\ p = \lambda w'.x \text{ bought } y \text{ in } w'\} \rightarrow p(w'')]\}$

$\{\lambda w''' \neg \exists r\ [r \in \{\lambda w'' \forall q\ [q \in \{p\text{: } \exists x \exists y\ x\ x \in [[\textbf{no student}]]^{w,g}\ \&\ y \in [[\textbf{every book}]]^{w,g}\ \&\ p = \lambda w'.x \text{ bought } y \text{ in } w'\} \rightarrow p(w'')]\}\ \&\ r(w''')]\}$

To see why this has to be ruled out, look at the line indicated with an arrow in (52). There we see that [∀] operates on a set of propositions of the form *that x bought y, for x a student and y a book*. All propositions of this form are true, [∀] says. In other words, the following is true: every student bought every book. [Neg] takes a singleton set of propositions as argument, namely, the proposition that every student bought every book. This proposition is now false, [Neg] says. Without Kennedy's generalization as understood above, the prediction made by the propositional theory for a case like (51) is that the sentence is true in case, e.g., not every student bought every book. This is clearly not a reading the sentence can have. Thus, [∀] is an intervener for the agreement relation between [Neg] and *no student*.[22]

To summarize the argument in this section. The propositional theory, because it must allow disassociation as a matter of principle in order to generate the split scope readings of negative indefinites and comparative quantifiers, predicts unattested split scope readings. It may be possible to solve the problem as it arises for universal QPs by appealing to an anti-

[22] The other split scope reading that is logically possible for this sentence, in (i), can be ruled out either as a result of the anti-singleton condition on *every* (see above), or as part of Kennedy's generalization:

(i) [∀] [[Neg] [no student bought every book]] singleton constraint in the lexical semantics of [∀]. However, the problem was shown to arise in other cases too, particularly, where [Q]-agreement was involved. We showed that the propositional theory is forced to say that intensional verbs (or, rather, the [∃] operator they introduce) have to be classified as interveners for [Q]-agreement but not for [Neg]-agreement—a statement that is not independently justified. We showed that the facts that fall under Kennedy's generalization display the same configuration as intervention effects in the propositional theory. There is an acute need to complement the propositional theory with a theory of locality/intervention that makes the right predictions. The claimed advantage of the propositional theory in the domain of locality disappears once disassociation is allowed, since an independent theory of syntactic locality becomes necessary again. In fact, the advantage turns into a disadvantage once disassociation is allowed, since the required theory of locality looks far from principled.

3.2 No movement for scope

A second over-generation problem with the propositional theory arises when we look at the entire class of intensional verbs taking non-finite complements in German. It is well known that such verbs subcategorize for complements that can be bare infinitives, participles, or infinitives with *zu* 'to'. Following Bech (1955/57), the literature on German calls this *status government*. Verbs taking bare infinitives and participles always take their complements to the left and exhibit an essentially mono-clausal structure. Verbs taking infinitives with *zu* are divided into further subclasses, those that do and those that do not show mono-clausal behavior when taking their complements to the left (see Wurmbrand 2003, Reis and Sternefeld 2004). Rightward complements are never mono-clausal in German.[23] As we show below, a mono-clausal structure is a precondition for scope splitting.

Consider again the contrast between *müssen* 'must' and *bedauern* 'regret' (section 2.2.3). *Müssen* takes a bare infinitival complement, has a mono-clausal structure, and allows split scope. *Bedauern* takes an infinitive with *zu* to the left but has a bi-clausal structure. Split scope of negative indefinites and comparative quantifiers is possible across *müssen* but not across *bedauern*. We illustrated this for *bedauern* in (33), repeated here for convenience:

(53) *German*

…weil	er	kein	Buch	geschrieben	zu	haben	bedauert
…because	he	no	book	written	to	have	regrets

'...because he regrets not having written a(ny) book'
* '...because he doesn't regret having written a book'

Recall that a contrast also arises with verbs like *erlauben* 'allow'. When *erlauben* takes its complement to the left, it is compatible with a mono-clausal structure and allows scope splitting, but when the complement appears extraposed to the right, the structure is clearly bi-clausal and scope splitting is disallowed (see examples (31), (32), (35) and (36) above).

Consider now that the following apparently unobjectionable LF would give rise to the unattested split scope reading under the propositional theory:

(54) [Neg] ... regret+[∃] ... no book

[23] The only exception might be the so-called *third construction*, which is marginal in German (see Wöllstein-Leisten 2001).

This poses an over-generation problem for the propositional theory. We don't see a principled way to prevent this type of analysis for *bedauern*. Nothing in the propositional theory prevents *bedauern* from having its nuclear scope existentially closed. Also, nothing in the propositional theory prevents a propositional quantifier, such as [Neg], from agreeing with a determiner, like *kein* 'no', that occurs inside of an extraposed clause. That is, the propositional theory has no natural way of expressing the connection between mono-clausality and scope splitting.

Our diagnosis of this problem will not be complete until we reach section 4.2.3, where we give our own account of the facts. We give a preview here though. Our account of scope splitting relies on movement. Mono-clausal infinitives are known independently to be transparent for a number of movement operations that bi-clausal ones aren't. The propositional theory cannot appeal to this distinction, since the scoping mechanism is crucially not based on movement.[24] We therefore claim that it necessarily misses an important generalization.

4 Choice function quantification

4.1 How choice function quantification accounts for split scope

The choice function theory was proposed by Abels and Martí (2010) to deal with split scope, though the theory itself originates with Fox's (1999, 2001, 2002) and Sauerland's (1998, 2004) attempts at developing a semantics for the copy theory of movement. To recap, in this approach, quantificational determiners are quantifiers over choice functions. Quantificational phrases undergo movement and leave a copy behind.[25] A process of (complementary) deletion occurs afterwards. In the resulting structure, a deleted quantificational determiner is interpreted as a variable with the type of choice a function, i.e., <et,e>:

(55) Movement, with copy: [every book] ... [every book]
Deletion: [every ~~book~~] ... [~~every~~ book]

The quantificational determiner is deleted at the foot of the movement chain but the common noun restriction is deleted at the head. In addition, in this approach, the world index of common nouns like *tie* is crucially involved in the derivation of split scope. This index is bound by the intensional verb and, very much as in Kratzer (1998), gives the illusion of low existential scope (i.e., it introduces co-variation with respect to the worlds quantified over by the intensional verb). Low existential scope, as we saw before, is also part of split scope readings, which are always *de dicto* readings.

To illustrate in detail now, consider (56) again:

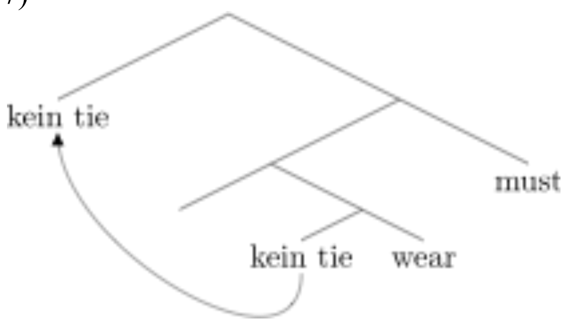
[24] That is not to say that there is no movement/QR in the propositional theory. Indeed, it is possible for QPs to move in this approach. Importantly, though, in order to take scope, they don't have to. Thus, movement is not a necessary ingredient for scope taking in this approach.

[25] Abels and Martí (2010) remained uncommitted on the question whether this movement is overt or covert. There is now reason to think that it is overt. Salzmann (2011) argues that split scope of QPs in the verb projection raising construction in Swiss German requires word order that we would analyze as generated by neutral scrambling of those QPs. Neutral scrambling in the Germanic OV languages is overt movement in the *Mittelfeld* under neutral intonation. Salzmann's work shows that the connection between movement and split scope is quite tight in that scope splitting of a QP requires overt movement of that QP. This kind of effect of overt movement for scope-splitting is unexpected under the propositional theory. For related facts see also Haegeman and van Riemsdijk (1986), Haegeman (1988), and Haegeman (1992).

(56) *German* (=(1), (12))
Zu dieser Feier musst du keine Krawatte anziehen
'To this party you don't have to wear a tie'

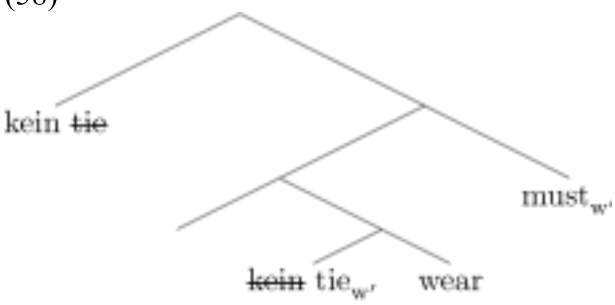
(57) illustrates the first step of the derivation, where *keine Krawatte* 'no tie' moves to a position above the intensional verb:

(57)



In a second step, the quantificational determiner is deleted downstairs and the common noun is deleted upstairs:

(58)



The question then is how to interpret this structure. Notice that one immediate problem to solve is how to combine the main verb with its object. Importantly, the deleted copy of the quantificational determiner is interpreted as a variable over choice functions. This choice function variable takes the noun restriction as its argument and returns an individual. *No* is, then, a quantifier over choice functions:

(59) $[\![\textbf{no}]\!] = \lambda S_{<<et, e>, t>}.\neg\exists f\ CF(f)\ \&\ S(f) = 1$

(60) shows the interpretation that is derived:

(60) $[\![\textbf{(56)}]\!] = 1$ iff $\neg\exists f\ CF(f)\ \&\ \forall w'\ R(w')(@)$, you wear $f(tie_{w'})$ in w'

To understand what this means, consider the following table:

	W1	W2	W3	W4	W5	W_n
f_1	tie1	tie2	tie3	tie4	✗	...
f_2	tie1	✗	✗	✗	✗	...
f_3	✗	tie2	✗	✗	✗	...
f_4	✗	✗	tie3	✗	✗	...
f_5	✗	✗	✗	tie4	✗	...
f_m	...	...	...	...	✗	...
	tie(s) worn	tie(s) worn	tie(s) worn	tie(s) worn	no tie worn	...

Table 1 Negative indefinites
('✗' stands for a tie that is picked by a choice function but is not worn, and '...' indicates that the state of affairs in a particular world with respect to what the choice function picks, or with respect to whether a tie is worn, is irrelevant)

The truth-conditions in (60) say that there is no way of picking such that in every accessible world w', you wear ties in w' that are so picked. Looking now at Table 1, notice that possible world W5 is such that no ties are worn by you in it at all. This makes it impossible to find a choice function such that it picks ties that you wear in every world—W5 will always be an exception. The state of affairs depicted in this table is such that the truth-conditions in (60) are verified (another state of affairs that would have the same effect is one in which you wear no tie in any accessible world). This is the split scope reading of the negative indefinite.[26, 27]

For comparative quantifiers, the analysis is the same up to the interpretation of the quantifier, of course. It is assumed to be as follows:

(61) $[[\textbf{less than three}]]^w = \lambda S_{<<et,\ e>,\ t>}.\neg\exists f\ CF(f)\ \&\ S(f) = 1\ \&\ \underline{dom(f) = \{p \mid \exists x \in p\ \#x \geq 3\}}$ $\&\ \underline{\forall p\ p \in dom(f) \rightarrow \#f(p) \geq 3}$

Weniger als n 'less than three' is a negative existential quantifier over choice functions. It contains two additions to its meaning when you compare it with *kein* 'no' ((59)). These two additions are underlined in (61). The first addition says that the choice function quantifier operates only over sets of entities of type <e,t> that have a member with three or more atoms[28]—that is, the sets the choice function operates on contain at least one big-enough member (there won't be sets in this domain that contain only atomic individuals, for example, or plural individuals containing just two atoms). The second addition says that we are only considering choice functions that always pick out objects made up of three or more atoms. The comparative quantifier, suitably combined with a sister S of type <<et, e>, t>, says then that there is no choice function with these characteristics and that yields true when fed to S.

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[26] For much more detailed discussion, see Abels and Martí (2010).

[27] Gennaro Chierchia (p.c.) asks us whether the choice function theory predicts that split scope readings should be available as long as there is binding, e.g., of a pronoun. That is, the choice function theory would seem to predict that sentences such as (i) should give rise to a split scope reading, when such a reading is not attested:

(i) Every journalist interviewed no friend of his/less than three friends of his

The split scope reading for (i), however, is ruled out by Kennedy's generalization.

[28] Where plural individuals are used in the account of plurality (this is also the choice made in Abels and Martí 2010). It doesn't seem that this choice affects the proposal in substantive ways.

Because of how universal and existential intensional verbs interact with this negative existential, we get *at least* readings with universal modals and *at most* readings with existential modals, without stipulation—these are the split scope readings of comparative quantifiers we discussed earlier. Consider (62) again:

(62) *German* (= (20))

Am	MIT	muss	man	weniger	als	drei	Bücher	veröffentlichen,
at.the	MIT	must	one	less	than	three	books	publish
um	fest			angestellt	zu	werden		
in.order	permanently			employed	to	be		

‘At MIT one must publish fewer than three books in order to get tenure’

The truth-conditions (informal) we obtain are in (63):

(63) [[**(62)**]]= 1 iff there is no choice function that picks triplets or bigger tuples such that in all worlds w’ one publishes the triplets or bigger tuples of books that it picks

Again, it is useful to look at a table:

	W1	W2	W3	W4	W5	W6	W7	W_n
$3^+ f_1$	books 1, 2, 3	books 3, 4, 5, 6	✗	books 1, 4, 5, 6, 7, 8	✗	✗	✗	...
$3^+ f_2$	books 2, 3, 4	✗	books 1, 5, 6	✗	books 7, 8, 9, 10, 11	✗	✗	...
$3^+ f_3$	✗	✗	books 1, 5, 6	✗	✗	✗	✗	...
$3^+ f_4$	books 1, 2, 3	✗	✗	✗	✗	✗	✗	...
$3^+ f_5$	books 1, 2, 3	books 3, 4, 5, 6	books 1, 5, 6	books 1, 4, 5, 6	books 7, 8, 9, 10, 11	✗	✗	...
$3^+ f_6$	✗	✗	✗	✗	books 1, 2, 3, 4, 5, 6, 7, 8	✗	✗	...
$3^+ f_m$	these functions choose books in such a way that total books published in each world doesn’t change from number specified in row below					✗	✗	...
	4 books published	4 books published	3 books published	6 books published	11 books published	(1 book published)	(2 books published)	book(s) published

Table 2 Comparative quantifiers
(‘✗’ and ‘...’ as before. Material in brackets indicates books published that are not chosen by 3^+ choice functions, following the assumption that you need to publish at least one book in order to get tenure)

The case we illustrate here is one in which we consider only choice functions that pick individuals with three or more atoms—other choice functions are excluded anyway from consideration. On the left-hand-side column we list some of these functions. In all the accessible worlds considered, at least one book is published (this is to comply with the assumption, discussed before, that one doesn’t get tenure at MIT if one publishes no books whatsoever). In some of those worlds, three or more books are published. If you look at all the worlds considered, however, there is no choice function that picks a collection of three or more books that one publishes in all worlds. There are choice functions that pick such triplets or bigger tuples in some worlds, but there isn’t one that does so in all worlds. If such a function existed, then one would publish three or more books in all worlds, and that’s not the split scope reading. That is, the truth-conditions obtained in this way say that the requirement is not that one publish three or more books. That, together with the assumption that you have to publish at least one book, results in the split scope reading, an *at least* reading.

One argument that Abels and Martí (2010) use to support their analysis is that it provides a unified approach to split scope, which we've discussed in section 2.2.3. Another argument is that, if you adopt choice function quantification, the fact that all natural language quantified determiners are conservative follows as a theorem.

4.2 How choice function quantification avoids the over-generation problems

4.2.1 Problems due to disassociation

Abels and Martí (2010) show that, as a consequence of how their system is designed, it follows that only non-upward monotone quantifiers[29] give rise to split scope readings that are truth-conditionally distinct from other scope readings. In particular, they show that, e.g., for a quantifier like *every*, the split scope reading that their system generates is equivalent to the plain narrow scope *de dicto* reading. Consider again (37). (64) shows the (informal) truth-conditions that are obtained in the choice function approach for this sentence:

(64) All choice functions f and all worlds w' are such that you buy in w' a w'-book picked by f

This is true if you buy all ties in all accessible worlds. Suppose we consider choice function f_1; then, f_1 picks a book that you buy in W1, and it picks a book that you buy in W2, and so on for all worlds. Then let's look at choice function f_2: f_2 picks a book that you buy in W1, and a book that you buy in W2, etc. And so on for all choice functions. Since, for each book, there is a choice function that picks it from a set of books, this is equivalent to the narrow scope, *de dicto* reading of the sentence. The split scope reading for *every* that the choice function theory predicts is equivalent to the narrow scope, *de dicto* reading also when the intensional verb is existential.

Thus, whereas the choice function theory makes the right cut between those quantified determiners that give rise to truth-conditionally distinct split scope readings and those that do not, the propositional theory predicts truth-conditionally distinct split scope readings for quantified determiners that do not, in fact, give rise to such readings, as we saw in section 3.2.1. There is nothing the choice function theory needs to add in order to make the right predictions here; in particular, the choice function theory does not need to appeal to Sauerland's (2008) anti-singleton constraint on the domain of *every*—though it is compatible with it, and it is possible to incorporate it into the choice function semantics of *every*.[30]

What predictions the choice function theory makes regarding *wh*-questions and Beck-effects are difficult to see without developing a proper syntax and semantics for them within this framework. Unfortunately, doing this is the topic of a separate paper—in great part because it depends on what one's theory of *wh*-movement is. We would like to stress, however, that the choice function theory is not designed to account for Beck-effects, anymore than quantification over individuals is—so, in the absence of a theory that can do split scope and derive intervention effects properly, these effects cannot be used against the choice function theory.

Regarding Kennedy's generalization, we first note that Kennedy's generalization can

[29] If the quantifier is upward entailing in just one of its argument, e.g., as in the case of *every*, then it counts as an upward-entailing quantifier for the purposes of this generalization.

[30] How to do this depends on a number of factors that are unrelated to the matter at hand. Notice, however, that the choice function theory can impose constraints on the domain of choice functions if need be; see the lexical entry for *weniger als n* 'less than n' in (61), for example.

be implemented syntactically or semantically in the choice function theory. To see what a possible syntactic implementation looks like, consider again the following example:

(65) *German* (=(27), (49))
Genau ein Arzt hat kein Auto
'Exactly one doctor has no car'
*'There isn't exactly one doctor who has a car'

In order to capture the fact that this and similar sentences lack a split scope reading, the choice function theory can impose a constraint on complementary deletion. After *kein Auto* 'no car' moves to a position above *genau ein Artz* 'exactly one doctor'[31], complementary deletion would delete the copy of the common noun restriction upstairs and the determiner downstairs. This is the operation that can be restricted: selective deletion cannot affect a QP when another QP intervenes. A semantic implementation of the generalization, that is, a constraint on scope, would also be possible, though we don't explore that here. The syntactic version of the generalization, i.e., as a constraint on complementary deletion, should be recognized as a stipulation, and we accept that it is. However, we do not think that this puts the choice function theory necessarily at a disadvantage, since we have seen in section 3.1 that the propositional theory can only account for the facts if it stipulates which operators count as interveners for agreement and which ones don't.

Finally, it's important to see that in the choice function theory, Kennedy's generalization and Beck's generalization need not boil down to the same thing—so the possibility is afforded here that the two have different causes, which may allow us to make the right predictions.

4.2.2 Problems due to the lack of movement for scope

The second problem for the propositional theory discussed above in section 3.2 was also an over-generation problem. We showed in section 2.2.3 that there are verbs that can split scope and that there are verbs that cannot. *Müssen* 'must' and *erlauben* 'allow', for example, can, but *bedauern* 'regret' cannot. In addition, *erlauben* does not allow split scope when its infinitival complement is extraposed. The choice function theory handles these facts by relating them to independently known properties of these verbs. These independent properties are that *müssen* always forms a mono-clausal structure with its complement, that *erlauben* may form a mono-clausal structure with its complement, but only when the complement is not extraposed, and, finally, that *bedauern* never forms a mono-clausal structure with its complement. Some of the traditional diagnostics used for the mono-clausal versus bi-clausal status of the structure involve movement. Neutral, non-focus scrambling of the object of the infinitive, for example, is possible in the mono-clausal structure but degraded in the bi-clausal structure. This is shown in the following examples:

(66) *German*

...dass	der	Mann	das	Essen	mehrmals	aufwärmen	muss
that	the	man	the	food	repeatedly	reheat	must

'...that the man must reheat the food repeatedly'

[31] The movement of the whole QP, of course, cannot be constrained, or otherwise the choice function theory would not be able to generate wide scope readings.

(67) *German*

... dass ein Arzt dem Mann das Essen mehrmals aufzuwärmen
that a doctor the man the food repeatedly reheat
erlaubt hat
allowed has
'...that the doctor allowed the man to reheat the food repeatedly'

(68) *German*

??...dass ein Arzt dem Mann das Essen mehrmals erlaubt hat aufzuwärmen
'...that the doctor allowed the man to reheat the food repeatedly'

(69) *German*

??...dass der Mann das Essen mehrmals aufgewärmt zu haben
that the man the food repeatedly reheat to have
bedauert (hat)
regretted has
'...that the man regretted having reheated the food repeatedly'

Example (66) is ambiguous between a reading where *mehrmals* 'repeatedly' modifies *aufwärmen* 'reheat' (where the man has to do the following: repeatedly reheat the food) and one where it modifies *müssen* 'must' (where the man is repeatedly obliged to reheat the food). What concerns us here is the latter reading. On this reading, the object of *aufwärmen*, *das Essen* 'the food', must have scrambled past the adverb attached to the higher verb, since it precedes it. Because the infinitival complement of *müssen* always gives rise to a mono-clausal structure, this movement is allowed. The same two possibilities arise in example (67), which has the reading where repeated acts of giving permission are described. This reading requires, again, scrambling of the object past a modifier of the higher verb, and is allowed because when the infinitival complement of *erlauben* is not extraposed, it gives rise to a mono-clausal structure. In example (68), *mehrmals* unambiguously modifies *erlauben*, but the infinitival complement of *erlauben* is extraposed. We are dealing with a bi-clausal structure and, as a result scrambling becomes degraded.[32] Finally, example (69) is also degraded and, when interpreted, unambiguous. It only has the reading where *mehrmals* modifies *aufwärmen*. The structure where *mehrmals* modifies *bedauern* is blocked because *bedauern* is compatible only with a bi-clausal structure and this bi-clausal structure is incompatible with neutral scrambling.

We claim that, empirically, only those verbs allow scope splitting that can appear in the mono-clausal structure and only when they do so. The choice function theory can use this correlation as part of the explanation, since under the choice function theory split scope is derived via movement. The examples with *bedauern* and those with an extraposed complement of *erlauben* receive the same explanation.

Recall that the propositional theory does not postulate any movement in order to derive split scope, so that appeal to independently known, movement-related distinctions within the class of infinitival complements won't be possible.

5 Conclusions and questions

In this article we have argued that split scope data can be useful in teasing apart two theories of natural language quantification, namely, the propositional theory (Kratzer 2005,

[32] Intonation must be kept neutral throughout.

Kratzer and Shimoyama 2002) and the choice function theory (Abels and Martí 2010).

We showed, first, that the propositional theory can handle split scope readings if disassociation is allowed. We then identified two over-generation problems. These had to do with the type of quantified determiner that gives rise to split scope and the type of intensional verbs that can split scope. Over-generation problems are less severe than under-generation problems, and, assuming disassociation, we did not find any under-generation problems. However, when the propositional theory is compared to the choice function theory, the balance seems to tip in favor of the choice function theory. This is so because the choice function theory makes the right distinctions (between quantified determiners that give rise to split scope and those that do not; between scope-splitting and non-scope-splitting verbs) without appealing to additional stipulations. In the case of the quantified determiners that give rise, or not, to split scope, it just falls out from the meanings independently given to these determiners that truth-conditionally distinct split scope readings are, or aren't, predicted. In the case of the intensional verbs that can or cannot split scope, the choice function theory can naturally appeal to independently established classes of verbs that differ on whether movement operations are allowed from within their non-finite complements—movement being an important ingredient in the choice function approach to (split) scope.

What does this tell us about the nature of natural language quantification? One thing we can conclude is that, contrary to the propositional theory, it cannot be the case that <u>all</u> natural language quantification is propositional, though it may be that <u>some</u> natural language quantification works this way. We can also say, positively, that at least <u>some</u> natural language quantification is choice function quantification—we have shown that this is a better approach for split scope. Also, choice function quantification can do what individual quantification can do (perhaps even in a better way, since, e.g., conservativity falls out as a theorem in the former but not in the latter; see Abels and Martí 2010 for the proof), and it can also do more, so it is possible that there is no individual quantification at all in natural languages (at least, that natural language quantified determiners do not quantify over individuals).

Certain questions arise regarding this work that we haven't touched upon here, but which are worth exploring further. Most immediately, there is the question of how well choice function quantification extends to other scope splits, such as *how many*/*combien* splits. Actually, how well does the propositional theory deal with these, for that matter? Also, if quantified determiners quantify over choice functions, what do adverbial quantifiers quantify over? Do they give rise to split scope?

These are obviously important issues that need to be explored, but we hope to have shown in this article that there are currently good reasons for suspecting that choice function quantification is a better approach to the nature of quantification in natural languages than is propositional quantification.

References

Abels, K. and L. Martí (2010) 'A Unified Approach to Split Scope', Natural Language Semantics **18**: 435-470

Aloni, M. and R. van Rooij (2007) 'Free Choice Items and Alternatives', in G. Bouma, I. Kraemer, and J. Zwarts, (eds.) *Cognitive Foundations of Interpretation*, Edita KNAW

_____ and A. Port (2010) 'Epistemic Indefinites Cross-linguistically', in N. LaCara, Y. Park and L. Fainleib (eds.), *Proceedings of NELS 41*, University of Massachusetts, Amherst: GLSA.

Alonso-Ovalle, L. (2006) *Disjunction in Alternative Semantics*. Ph. D. dissertation, University of Massachusetts, Amherst, MA.

_____ and P. Menéndez-Benito (2010) 'Modal Indefinites', Natural Language Semantics **18**: 1-31

Bech, G. (1955/57), *Studien über das deutsche Verbum infinitum*, Danske Vidensk-abernes Selskab: Historisk-filologiske meddelelser, Munksgaard, Kopenhagen

Beck, S. (1996) 'Quantified Structures as Barriers for LF Movement', Natural Language Semantics **4**: 1-56.

_____ (2006) 'Intervention Effects Follow from Focus Interpretation', Natural Language Semantics **14**: 1-56

Beghelli, F. and T. Stowell (1997) 'Distributivity and Negation: The Syntax of *Each* and *Every*', in A. Szabolcsi (ed.) *Ways of Scope Taking*. Dordrecht, Kluwer, 71-107.

Büring, D. (1995) *The 59th Street Bridge Accent. On the Meaning of Topic and Focus*, Universität Tübingen Ph.D. dissertation

Butler, J. (2004) *Phase Structure, Phrase Structure, and Quantification*, University of York Ph.D. dissertation.

Fox, D. (1999) "Reconstruction, Variable Binding and the Interpretation of Chains", Linguistic Inquiry **30**: 157–196

_____ (2001) "The Syntax and Semantics of Traces", talk given at the University of Connecticut

_____ (2002) "Antecedent-Contained Deletion and the Copy Theory of Movement", Linguistic Inquiry **33**: 63-96

_____ and R. Katzir (2011) "On the Characterization of Alternatives", Natural Language Semantics **19**: 87-107

Geurts, B. (1996) 'On *No*', *Journal of Semantics* **13**: 67-86

Hackl, M. (2001) Degree Quantifiers, MIT Ph.D. dissertation

Haegeman, L. (1988) "Verb Projection Raising and the Multidimensional Analysis: Some Empirical Problems", Linguistic Inquiry **19**:671–684

_____ (1992) *Theory and Description in Generative Grammar. A Case Study in West Flemish*, Cambridge University Press, Cambridge

_____ and H. van Riemsdijk (1986) "Verb Projection Raising, Scope and the Typology of Rules Affecting Verbs", Linguistic Inquiry **17**:417–466

Heim, I. (1982) The Semantics of Definite and Indefinite Noun Phrases, Ph.D dissertation, UMass Amherst

_____ (2001) 'Degree Operators and Scope', in C. Féry and W. Sternefeld (eds.) *Audiatur Vox Sapientiae: A Festschrift for Arnim von Stechow*, Studia Grammatica 52, Akademie Verlag, Berlin, 214-239

_____ (2010) "Compositional Semantics of Questions and *Wh*-Movement", lecture notes, Fall 2010, MIT

Jacobs, J. (1980) 'Lexical Decomposition in Montague Grammar', *Theoretical Linguistics* **7**: 121-136
Kamp, H. (1981) 'A Theory of Truth and Semantic Representation", in J.A.G. Groenendijk, T.M.V. Janssen, and M.B.J. Stokhof (eds.), *Formal Methods in the Study of Language*, Mathematical Centre Tracts 135, Amsterdam, 277-322.
Kennedy, C. (1997) *Projecting the Adjective*, UCSC Ph.D. dissertation
Kratzer, A. (1998) 'Scope or Pseudoscope? Are there Wide Scope Indefinites?', in S. Rothstein (ed.) *Events in Grammar*, Kluwer Academic Publishers, 163-197
_____ (2005) 'Indefinites and the Operators They Depend On: From Japanese to Salish', in G. N. Carlson and F. J. Pelletier (eds.) *Reference and Quantification: the Partee Effect*, CSLI
_____ and J. Shimoyama (2002) 'Indefinite Pronouns: The View from Japanese', 3rd Tokyo Conference on Psycholinguistics
Lauer, S. (2010) "Some News about *Irgend-* and *Algún*", talk given at the *Workshop on Epistemic Indefinites*, Universität Göttingen
Menéndez-Benito, P. (2010) 'On Universal Free Choice Items', Natural Language Semantics **18**: 33-64
Nishigauchi, T. (1986) *Quantification in Syntax*, UMass PhD dissertation
_____ (1990) *Quantification in the Theory of Grammar*, Dordrecht: Kluwer.
Ohno, Y. (1989) 'Mo', in E. Bach et al. (eds.) *Papers on Quantification*, NSF Grant Report, Department of Linguistics, UMass, Amherst: GLSA 224-250
Penka, D. (2007) Negative Indefinites, Universität Tübingen Ph.D. dissertation
Potts, C. (2000) 'When even *no*'s NEG is Splitsville', *Jorge Hankamer WebFest*
Reis, M. and W. Sternefeld (2004) "Review of Wurmbrand's *Infinitives. Restructuring and Clause Structure*", Linguistics **42**:469-508
Rooth, Mats (1985) *Association with Focus*, UMass PhD dissertation
Rullman, H. (1995) 'Geen einheid', *Tabu* **25**: 194-197
Salzmann, M. (2011) "Resolving the movement paradox in verb projection raising", in O. Bonami and P. Cabredo Hofherr (eds.) *Empirical Issues in Syntax and Semantics 8*, 453-485
Sauerland, U. (1998) *The Meaning of Chains*, MIT Ph.D dissertation
_____ (2004) "The Interpretation of Traces", Natural Language Semantics **12**: 63-127
_____ (2008) "Implicated Presuppositions", in A. Steube (ed.), *Sentence and Context. Language, Context & Cognition*. Mouton de Gruyter, Berlin, Germany.
von Stechow, A. (1996) 'Against LF Pied-Piping', Natural Language Semantics **4**: 57-110.
Svenonius, P. (2002) 'Strains of Negation in Norwegian', *Working Papers in Scandinavian Syntax* **69**: 121-146
de Swart, H. (2000) 'Scope Ambiguities with Negative Quantifiers', in K. von Heusinger and U. Egli (eds.) *Reference and Anaphoric Relations*, Kluwer Academic Publishers, 109-132
Tancredi, C. and M. Yamashina (2004) "Interpretation of Indefinites in the Japanese wh-*mo* Construction", paper presented at the conference *Strategies of Quantification*, University of York
Tomioka, S. (2007) "Pragmatics of LF Intervention Effects: Japanese and Korean *Wh*-Interrogatives", Journal of Pragmatics **39**: 1570-1590
Wöllstein-Leisten, A. (2001) *Die Syntax der dritten Konstruktion*, Stauffenburg, Tübingen
Wurmbrand, S. (2003) *Infinitives. Restructuring and Clause Structure*, Mouton de Gruyter
Yamashina, M. and C. Tancredi (2005) 'Degenerate Plurals', in E. Maier, C. Bary and J. Huitink (eds.) *Proceedings of Sinn und Bedeutung 9*

Yatsushiro, K. (2009) "The Distribution of Quantificational Suffixes in Japanese", Natural Language Semantics **17**:141-173

Zeijlstra, H. (2004) Sentential Negation and Negative Concord, University of Amsterdam Ph.D. dissertation