Skolemization As Implicit Alienable Possession

Zahra Mirrazi

University of Massachusetts, Amherst

1 Problem

Chierchia (2001) and Schwarz (2001) observe that both existentially closed (Reinhart, 1997; Winter, 1997), and contextually given skolemized choice functions (Kratzer, 1998) generate unattested readings for indefinites in non-upward monotone contexts. Compare (1a) and (1b) in a scenario where Sue wrote two papers SP={S_1,S_2}, only submitted S_1, and Mary wrote two papers MP={M_1,M_2}, only submitted M_2.

(1) a. No candidate$_1$ submitted *a* paper they$_1$ had written.
b. No candidate$_1$ submitted *a certain* paper they$_1$ had written.

While (1a) is judged false in this scenario, (1b) is true. According to the choice functional analysis proposed by Reinhart (1997) and Winter (1997), a *choice function* variable introduced by an indefinite determiner can be bound by an existential quantifier at any level of the compositional derivation. Given the free scope of existential closure, two LFs in (2) can be assigned to the sentences containing indefinites in (1a) and (1b).

(2) a. No candidate$_1$ λ_1 [$\exists f$[t_1 submitted f [paper they$_1$ had written.]]]
b. $\exists f$[No candidate$_1$ λ_1[t_1 submitted f [paper they$_1$ had written.]]]

However, none of these sentences is ambiguous. The sentence (1a) only means that for no candidate there is a paper they wrote that they submitted. The LF in (2a) accounts for this interpretation. The LF in (2b) accounts for the interpretation of (1b), conveying that there's a way of choosing among papers that each candidate wrote such that no candidate submitted whatever paper is selected for them, namely a function that picks S_2 for Sue, and M_1 for Mary. Let us also consider the sentences in (3a) and (3b) in the following scenario: Smith and Baker are the teachers, both Sue and Mary (the students) read every book Smith praised, but only Sue read every book Baker praised.

(3) a. Not every student read every book *some* teacher had praised.
b. Not every student read every book *a certain* teacher had praised.

The sentence (3a) is judged to be false in this scenario, but (3b) is judged to be true. Two LFs in (4) can be assigned to the sentences containing indefinites in (3a) and (3b).

(4) a. $\neg\forall$x[student'(x) $\rightarrow \exists f\forall$z[praised'(z, f(book')) $\rightarrow$ read' (x,z)]]
b. $\exists f\neg\forall$x[read'(x) $\rightarrow \forall$z[praised'(z, f(x, book')) $\rightarrow$ student' (x,z)]]

The LF in (4a) accounts for the interpretation of (4a), conveying that not for every student, there is a way of choosing among teachers such that they read every book the chosen teacher for them has praised. The LF in (4b) accounts for the interpretation of (3b), conveying that there's a way of choosing among teachers such that not every student read every book praised

by the teacher that is selected for them, namely a function that picks Smith for Sue, and Baker for Mary. Therefore, a choice functional account has to be equipped with some constraints to exclude the LFs (2b) and (4b) for sentences containing *a/some* indefinites in (1a) and (3a), and the LFs (2a) and (4a) for sentences containing *a certain* indefinites in (1b) and (3b). To capture the behavior of *some/a* indefinites under non-upward entailing quantifier, Chierchia (2001) and Schwarz (2001, 2011) propose some constraints on existential closure of choice functions. These constraints either make reference to the monotonicity of the quantifier that binds the individual argument of the skolemized choice function, or restricts the position of the existential closure with respect to that quantifier (Chierchia, 2001; Schwarz, 2001). *a certain* indefinites, on the other hand, are proposed to introduce a contextually given free variable over skolemized choice functions (Kratzer, 1998; Schwarz, 2011). However, given the cost associated with such stipulative constraints, it has been doubted whether or not the semantics of indefinites involves choice functions (Schwarz, 2001, 2011).

2 Proposal

I propose that the functional dependency between a DP and a higher quantifier is built in the NP level. I introduce a type-shifter that introduces a functional dependency between a by shifting a $\langle e,t\rangle$-type noun to an $\langle e,\langle e,t\rangle\rangle$-type noun. As a result of this type-shifer, which I call SKOL, a functional variable R, and an individual variable x_i are introduced. R is free variable whose referent is contextually determined. The variable x_i has to be bound by a higher quantifier in the structure. The discourse referent of the functional variable introduced by SKOL has to be a total function.

(5) SKOL $P = \lambda a \in \text{A}.\ \lambda b \in \beta.\ [\ P(b) \wedge \text{R}(a,b)]$, where R is a total function.

The skolem function f denoted by the indefinite determiner takes this function, which is fed an individual pronoun a co-indexed with other bound variables in the larger structure, as argument and chooses a unique witness for every value of the variable a, as shown in (6).

(6) $f_{\langle\langle e,t\rangle,e\rangle}\ (\lambda b.P(b) \wedge \text{R}(a,b)) = b_i \in \text{B}$, which is equivalent to $f(\text{R}\ (a_i)) = b_i$

(7) $[\text{DP}_e\ [f_{\langle\langle e,t\rangle,e\rangle}\quad \text{NP}_{\langle e,t\rangle}\ [\text{pro}_i\quad \text{NP}_{\langle e,\langle e,t\rangle\rangle}[\text{SKOL}\quad \text{NP}_{\langle e,t\rangle}]]]]$

This has the effect of narrowing the NP restrictor of the skolem function to only those elements that are related to some a_i. The argument of this skolem function is not a set of individuals in the extension of the NP, but a function. Therefore, the restriction (P) of a skolem function will be restricted to only those individuals $b \in \beta$ that have been mapped to an $a \in$A. Thus, this skolem function is equivalent to a choice function over a singleton set (See also (Schwarzschild, 2002) for an analysis of indefinites as existential quantifiers which can be implicitly restricted to a singleton set.) A functional NP ($\lambda b.P(b) \wedge \text{R}(a\ b)$) presupposes that there is a function that maps every a to a b. The value of this functional variable comes from the context. The discourse model not only keeps track of a list of individuals that are relevant in the discourse, but also a list of salient relations (Groenendijk & Stokhof, 1991; Van der Does, 1992; Brasoveanu, 2007; Keshet, 2018). The discussion of how to formalize the discourse representation in order to find the referent of a relation variable is important but beyond the scope of this paper. For our current purpose, it suffices to have a discourse model that maintains the dependencies between individuals. The immediate advantage of

encoding the pragmatic component of the functional interpretation at the NP level, is that both types of indefinite determiners (*a/some* and *a certain*) can have a uniform semantics. They denote a skolem (choice) function which is existentially closed at the topmost level of the derivation (Matthewson, 1999). The implicit functional variable R, introduced via SKOL, is subject to a strong contextual felicity condition (Tonhauser et al., 2013; King, 2018) such that it can only be felicitously used in linguistic contexts that already entail them. Therefore, the existence of R has to be entailed by existing salient relations in the linguistic context of utterance. A functional reading of indefinites (both pair-list readings and natural functional readings) arises when the skolem function introduced by the indefinite determiner takes a functional NP as its argument. The specification of R has to come from the linguistic context. When an NP is modified via a relative clause, containing a variable that the choice of the witness depends on, as in (8a), it can provide a salient referent for R in the linguistic context.

(8) a. Every student$_i$ read every book some teacher they$_i$ like had praised.
b. $\exists f \forall$x [Student(**x**) $\rightarrow$ $\forall$y [book (y) $\wedge$ **praised-by**$_2$ (y, $f(\lambda z.teacher(z) \wedge$ R(**x**, z) $\wedge$ like(**x**, z))) $\rightarrow$ **Read**$_1$(**x**, y)]]

In (9a), for instance, an R which maps every student x to a teacher z who the student x *read* every book *praised by z* is computable from the composition of the existing relations *read* and *praised-by*.

(9) a. Every student read every book praised by some teacher.
b. $\exists f \forall$x [Student(**x**) $\rightarrow$ $\forall$y [book (y) $\wedge$ **praised-by**$_2$ (y, $f(\lambda z.teacher(z) \wedge$ R(**x**, z))) $\rightarrow$ **Read**$_1$(**x**, y)]]
R is computable in context: R(x,teacher) $\subseteq$ R(y, teacher) $\circ$ R(x,y)

In (10a), the presence of the NP modifier "*certain*"(Charlow, 2014) makes the accommodation strategy, which is otherwise unavailable, possible.

(10) a. Every student read every book praised by a certain teacher.
b. $\exists f \forall$x [Student(**x**) $\rightarrow$ $\forall$y [book (y) $\wedge$ **praised-by**$_2$ (y, $f(\lambda z.teacher(z) \wedge$ R(**x**, z))) $\rightarrow$ **Read**$_1$(**x**, y)]]
R is locally accommodated.

Although the intermediate scope is possible in all three cases above, this approach predicts that the intermediate scope of indefinite should be easier when the existence of R is lexically specified or locally accommodated by an indexical modifier like *certain*, because computing the R which is entailed in a given linguistic context, is costly. This captures Kratzer's intuition that intermediate readings, are more easily available when there are overt bound variables inside the indefinite phrase.

3 Solving the problems

As *certain* indefinites can locally accommodate the existence of a function R, this type of indefinites are predicted to always yield functional readings. There are, however, two cases where *some/a* indefinites cannot give rise to functional readings: (i) A lexically specified relation is not a total function. (ii) The existence of R is not entailed in the linguistic context. I show that all cases of problems in non-upward monotone contexts are due to either (i)

or (ii). Let us first consider (1a) and (1b), repeated here as (11a) and (11b) in the same context. We saw earlier that without a further constraint, both of these sentences can be assigned the LF in (11c). This wrongly predict both (11a) and (11b) can be true in this scenario. However, only (11b) is true in the given scenario.

(11) a. No candidate$_1$ submitted *a* paper they$_1$ had written.
b. No candidate$_1$ submitted *a certain* paper they$_1$ had written.
c. $(\exists)f$[No candidate$_1$ λ_1[t$_1$ submitted a$_{f_1}$ [paper they$_1$ had written.]]]

The new approach assigns the LF (12) to both (11a) and (11b).

(12) $\exists f$[No candidate(**x**) λ_1[t$_1$ submitted f [λz.paper(z)$\wedge$R(**x**, z)$\wedge$write(**x**, z)]]]

The sentence containing *a certain* indefinite in (11b) is predicted to be true in this scenario, as the existence of a total function R can be easily accommodated. The sentence (11a) with *some* indefinite, on the other hand, is only predicted to be true if R has a referent in the linguistic context. The relation *write* can serve as the referent of R if it is taken to be a total function. That is only the case when the function *write* outputs the unique *set* of papers each candidate wrote, i.e. R={$\langle Sue, \{S_1,S_2\}\rangle$,$\langle Mary, \{M_1,M_2\}\rangle$}. But the output of the skolem function which takes this R as argument does not verify (12). Therefore, the sentence is correctly predicted to be false in the scenario. In a context where the relationship *write* is a total function that returns a unique paper for every candidate such that the paper chosen is not submitted, the sentence (11c) becomes acceptable. Consider this context: Sue and Mary are students. They are supposed to submit two papers: a review of a paper they were assigned to read, and a paper they wrote on a topic of their choice. Sue's papers to submit are: SP={S$_1$,S$_2$}, but she only submitted S$_1$, which is the review of the article she was assigned. Mary's papers to submit are: MP={M$_1$,M$_2$}. Like Sue, she only submitted the paper she reviewed (M$_2$). The sentence (11a) is judged true in this context. Moreover, if the linguistic context entails the existence of a referent for the function R, the functional reading becomes available. Assume Sue and Mary disliked the papers that they didn't submit.(13a) is judged true, as predicted.

(13) a. No candidate$_1$ submitted **a** paper they$_1$ wrote but disliked.
b. $\exists f$[No candidate(**x**) λ_1[t$_1$ submitted f [λz.paper(z)$\wedge$R(**x**, z)$\wedge$write(**x**, z)$\wedge$dislike(**x**, z)]]]

Now consider (3a) and (3b), repeated here as (14a) and (14b), in the same context. (14a) and (14b) are predicted to be true in this context by both wide scope of existentially closed choice functions (Reinhart, 1997; Winter, 1997), and contextually given skolemized choice functions (Kratzer, 1998), because they can be assigned the LF in (14c). We can find a skolemized choice function f such that f(Sue, the teachers) = Smith, and f(Mary, the teachers) = Baker. But only (14b) is judged true. (14a) is judge as false in this scenario.

(14) a. Not every student read every book *some* teacher had praised.
b. Not every student read every book *a certain* teacher had praised.
c. $(\exists)f$[Not every student$_1$ λ_1[t$_1$ read every book some/a certain$_{f_1}$[teacher had praised.]]]

Under our approach, both (14a) and (14b) are assigned the LF in (15), where the restriction

of f is narrowed to only those teachers that have been mapped by R to a student.

(15) $\exists f \neg \forall$x [Student(**x**) $\rightarrow \forall$y [book (y) $\wedge$ **praised-by**$_2$ (y, f(λ z.teacher(z) $\wedge$R(**x**, z))) $\rightarrow$ **Read**$_1$(**x**, y)]]

The sentence (14b) is predicted to be true, as R can be easily accommodated. The sentence (14a), on the other hand, is only predicted to be true if R has a referent the linguistic context. Computing R(x,teacher) $\subseteq$ $R_{praised-by}$(y, teacher) $\circ$ R_{read}(x,y) from the information in the linguistic context, there are two possible total functions that can serve as a referent for R:R_1=$\{\langle Sue, Smith\rangle, \langle Mary, Smith\rangle\}$, and R_2=$\{\langle Sue, Baker\rangle, \langle Mary, Smith\rangle\}$. As none of these options verifies (15), The sentence containing *some* indefinite (14a) is correctly predicted to be false by this approach. If the linguistic context provides a suitable referent for R, sentences containing *some* indefinites are also predicted to render a functional reading. This prediction seems to be borne out. In the same scenario, further assume that Sue likes Smith and Mary likes Baker. (16a) is judged true in this context, as predicted. This shows that a functional reading can be available in non-monotonic context, provided that a suitable total function is linguistically given.

(16) a. Not every student$_i$ read every book **some** teacher they$_i$ like had praised.

b. $\exists f \neg \forall$x [Student(**x**) $\rightarrow \forall$y [book (y) $\wedge$ **praised-by**$_2$ (y, f(λ z.teacher(z) $\wedge$R(**x**, z) $\wedge$ like(**x**, z))) $\rightarrow$ **Read**$_1$(**x**, y)]]

4 Conclusion

In this paper, I propose a formalization of functional interpretation of indefinites which separates the functional dependency from the semantics of indefinite determiners. Under this account, both *a certain* and *a/some* indefinites uniformly introduce skolem functions f of type $\langle\langle e, t\rangle, e\rangle$ that are existentially closed in the topmost level of the derivation (Matthewson, 1999). The differences between two types of indefinites are derived pragmatically, without a need for stipulations. Moreover, the account of functional interpretation of indefinites presented in this paper is similar to the analysis of possessive description (Partee, 1986; Barker, 1995; Vikner & Jensen, 2002) and E-type pronouns (Kratzer & Heim, 1998) in containing a relational/functional noun which introduces a free relation/function variable whose referent is determined in the context. This is welcome, because they all seem to share two properties: (i) *Narrowing*, which is the property that a possessor DP or an E-type pronoun does not quantify over all individuals in the extension of NP, but only over those individuals which have a relation to another element. For instance, the fact that the sentence (17) is judged true shows that the quantifier *most* ranges only planets that have rings (Barker, 1995). Similarly in (18), when *it* is interpreted as *a bottle of wine*, it refers to *the bottle of wine every host bought*.

(17) Most planets' rings are made of ice.

(18) Every host bought a bottle of wine and served *it* with the dessert.

According to accounts that posit the existence of a relational/functional noun in the structure of these constructions, the narrowing property is the result of quantifying only over a relation/function. (ii) *Maximality effect*, which is the property that a possessor DP or an

E-type pronoun have maximal references. The requirement that the referent of R is a total function, also predicts that functional indefinites should also give rise to a similar effect. We have seen that it is indeed the case. As mentioned before, the witness of the indefinite in (19) is the set of *all* papers each candidate wrote.

(19) No candidate$_1$ submitted *a* paper they$_1$ had written.

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