The Interpretation of Indefinites in the Japanese wh-mo Construction

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1 Introduction
This paper proposes an analysis of wh-mo interaction in Japanese and explores consequences of the analysis for the interpretation of indefinite descriptions. Three important conclusions will be drawn: first, that mo is a non-group plural forming operator and not a universal quantifier; second, that indefinites to which mo is adjoined cannot be interpreted as generalized existential quantifiers, supporting Reinhart (1997); and third that a choice function analysis of indefinites is possible, but only if the analysis is intensionalized, a possibility not entertained by Reinhart.1

The example in (1) illustrates the basic phenomenon of wh-mo interaction.

(1) [NP[CP Dono-gakusei-ga kai-ta] ronbun]-mo shuppan-sareta
which-student-OM write-past paper-mo were-published

(A/The) paper(s) that whichever student wrote was/were published

The three main components of this construction are a wh-expression, here dono gakusei (which student), the particle mo, and the sister to mo which in the cases to be considered

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1 In the talk presented at the Strategies of Quantification conference, we based our analysis and argument on Shimoyama (2001) rather than on Kratzer and Shimoyama (2002). The most important difference between these analyses for the present paper is that Shimoyama (2001) introduces an operator associated with mo which is syntactically co-indexed with and hence semantically binds all wh-expressions free within its scope. The mechanisms required for making this approach work made available a very different solution to the problem of analying indefinites taken up at the end of this paper, one that involved choice functions operating directly on sets of variable assignment functions. While the analysis did succeed at overcoming the problems presented in section 5 below, it required introducing a new use of choice functions that is not independently supported. Furthermore, since indices play no significant role in Kratzer and Shimoyama (2002), the analysis we presented at the conference cannot be carried over or even easily adapted to fit with the assumptions of Kratzer and Shimoyama (2002). This has forced us to rethink the analysis presented at the conference, leading to the intensionalization of choice functions analysis of the present paper.
in this paper will always be a DP with a relative clause. As the English interpretation suggests, the DP can be given either a definite or an indefinite interpretation, and can be either singular or plural. The long distance interaction between the wh-expression and mo is similar in interpretation to the combination of a wh-expression and ever into a single word in English (e.g. whichever), though the similarity is only partial. In particular, while the semantic effects of ever in English are restricted to the single word it is a part of, in Japanese the semantic effects of mo affect the interpretation of the entire DP it is adjoined to. This makes literal translation into English impossible in many cases. The English translations given for the Japanese examples should thus be taken as suggestive of the true meaning rather than as definitive translations.2

The wh-mo construction has received a considerable amount of attention in the semantic literature since Nishigauchi (1986). Nishigauchi himself analyzed mo as an unselective binder, binding all indefinites – wh-expressions included – in its scope. His analysis assumes that wh-expressions are moved to the position of mo, either by themselves or within a pied piped DP. von Stechow (1996) provides a compositional semantic treatment of the wh-mo construction built upon Nishigauchi's analysis, but assumes further raising of wh-expressions out of pied piped clauses at LF. Shimoyama (2001) argues convincingly against both of these analyses and develops an alternative approach in which wh-movement is analyzed as strictly local adjunction to IP and in which there is no syntactic agreement between a wh-expression and mo. On her analysis, a wh-expression occurring in the syntactic scope of mo is interpreted semantically in the scope of mo as well. Tancredi and Yamashina (2002) develop an analysis of the construction within the framework of Dynamic Predicate Logic, in which wh-expressions are interpreted in a manner parallel to indefinites. Finally, Kratzer and Shimoyama (2002) (henceforth K&S) give a Hamblin semantics of the construction, extending and slightly revising the analysis of Shimoyama (2001). In K&S's analysis, wh-expressions denote sets of individuals and combine pointwise with arguments to form sets of higher types of expressions. Mo then operates over a set of individuals, universally quantifying over the elements of that set and combining them with the interpretation of the remainder of the sentence.

In this paper, we take K&S as a starting point, referring the reader to

2 In some cases, the English translation given is ungrammatical but interpretable. This should not be taken to indicate a corresponding ungrammaticality in the Japanese
Shimoyama (2001) for extensive criticism of previous proposals. In section 2, we review the analysis of K&S. Then in section 3 we show that this analysis fails to allow for quantificational variability when a moP co-occurs with an adverb of quantification. In section 4 we propose modifications to K&S that overcome these problems. In section 5, we show that standard analyses of indefinites are incompatible both with the analysis developed in section 4 and with K&S, and in section 6 we develop an alternative treatment of indefinites that can be combined with either of these analyses. Finally, section 7 contains the conclusion.

2 Kratzer and Shimoyama (2002)

The analysis of K&S has many advantages over previous proposals. First, it is strictly compositional. Second, it does not require an *ad hoc* stipulation that wh-expressions be syntactically bound – the binding of wh-expressions falls out directly from the semantics without any need for syntactic indexing. Finally, it is conceptually and technical simple and completely general. Here is a brief summary of that analysis:

(i) All non-wh-expressions denote (typically singleton) sets of 'traditional' denotations.
(ii) Wh-indefinites denote (non-singleton) sets of individuals, viewed as alternatives.
(iii) Composition of two set-denoting expressions creates a new set of alternatives via pointwise functional application of the members of the two sets.
(iv) *Mo* is a generalized universal quantifier.

K&S do not directly address the question of how to interpret DPs, though their analysis tacitly assumes a referential (type e) analysis of these expressions.

In (2) we give K&S's analysis of Hamblin Functional Application. Then in (3) we give illustrative semantic interpretations consistent with their analysis, and in (4) the resulting interpretation of example (1) under the assumption that the DP is interpreted as a definite description.

2 Hamblin Functional Application

If a node \( \alpha \) has daughters \( \beta \) and \( \gamma \), and \( [[ \beta ]]^{w_d} \subseteq D_{e,x} \) and \( [[ \gamma ]]^{w_d} \subseteq D_{e,x,t} \), then

\[
[[ \alpha ]]^{w_d} = \{ a \in D_e : \exists b \exists c \ [ b \in [[ \beta ]]^{w_d} \& c \in [[ \gamma ]]^{w_d} \& a = c(b)] \}.
\]

(3) \[ [[ \text{ dono} ]]^{w_d} = \{ \lambda P. \{ x : P(x)(w) \} \}^3 \]

example being translated.

3 Here and throughout we use italics for intensional variables and normal type for non-
[[ gakusei ]]^{w_g} = \{ \lambda x \lambda w', \text{student}(x)(w') \}

[[ \alpha\text{-mo} ]]^{w_g} = \{ \lambda P \lambda w', \forall a \ [a \in [[ \alpha ]]^{w_g} \Rightarrow P(a)(w') = 1 \} \}

\{ \lambda w', \forall a \ [a \in \{x: \exists y (\text{paper}(y,w') \& \text{student}(z,w') \& \text{wrote}(z,y,w'))]\}] \}

\rightarrow \text{was-published} (a,w') \}

Presumably, (1) will be true just in case the singleton member of the set in (3) applies truthfully to the actual world.

3 A Problem with Adverbs

Adding an adverb of quantification such as taitei to a wh-mo sentence such as (1) can potentially add an ambiguity to the sentence. In one reading, the wh-phrase appears to be quantified by a universal quantifier and some expression other than the wh-phrase is associated with the adverb of quantification. In the other reading, the wh-phrase itself appears to be associated with the adverb of quantification. These two readings are illustrated in (5), assuming a definite plural interpretation for the DP.

(5) [DP[CP Dare-ga kai-ta ronbun]-mo taitei shuppan-sareta who-NOM write-past paper-mo usually were-published

The papers that whoever wrote were usually published

a. Each person had most of their papers published; OR

b. Most people had all of their papers published

The difference in interpretation can be illustrated by taking (5) to be uttered in the two contexts given in (6).

\begin{align*}
\text{person} & \quad \text{paper} \\
1 & \quad a \\
& \quad b \\
& \quad c \\
2 & \quad d \\
& \quad e \\
& \quad f \\
3 & \quad g \\
& \quad h \\
\end{align*}

\begin{align*}
\text{person} & \quad \text{paper} \\
1 & \quad a \\
& \quad b \\
& \quad c \\
2 & \quad d \\
& \quad e \\
& \quad f \\
3 & \quad g \\
& \quad h \\
\end{align*}

intensional variables.
Intuitively, it is possible for (5) to be true in each of these situations. Under the (5a) interpretation it will be true in (6a) and false in (6b), while under the (5b) interpretation the judgments will be reversed. However, K&S’s analysis fails to generate such an ambiguity for (5). To see this, assume that the adverb taiteti introduces a propositional operator into the semantics glossed as MOST. Furthermore, assume that MOST can quantify over the parts of any variable free in its scope. If we further allow the relative scopes of taiteti and moP to be free, we then generate the following as interpretations for (5) (ignoring worlds).

\[
\begin{align*}
\text{(7)} & \quad \forall a \left[ a \in \{x : \exists z [x = \sigma y(papers(y) \& student(z) \& wrote(z,y))]\} \right] \\
& \quad \rightarrow \text{MOST (was-published (a))}
\end{align*}
\]

b. MOST (\(\forall a \in \{x : \exists z [x = \sigma y(papers(y) \& student(z) \& wrote(z,y))]\}\) \\
\quad \rightarrow \text{was-published (a)})

Given a plausible interpretation of the operator MOST, (7a) can generate the interpretation given in (5a) by quantifying over parts of the free variable a. However, it cannot plausibly generate (5b) as an interpretation, and nor can (7b). Indeed, in (7b) there is no variable free in the scope of MOST, and hence nothing it can possibly bind. Thus, with the representation in (7a), K&S can correctly predict the possibility of (5) being true in situation (a). However, they generate no interpretation that is true in situation (b). Truth in the latter situation could be captured by taking MOST to replace rather than precede the universal quantifier in (7b), but there is no way of generating such a representation under their analysis since the universal quantifier is part of the lexical meaning of mo.

4 An I-sum Analysis of Mo-Phrases

To fix the problem encountered by K&S, we separate universal quantificational force off from the particle mo, and analyze it as coming instead from a covert distributive operator needed independently to give a distributive interpretation for plurals. We

\footnote{The particular analysis assumed for the adverbs is non-essential to the point they are being used to make. We have used the analysis in the text because it simplifies presentation. A more adequate analysis could be based on Rothstein (1995) or de Swart (1993), though we do not pursue such an analysis here. A fuller and more satisfactory integration of adverbs of quantification and the wh-mo construction is worked out in Tancredi and Yamashina (in progress).}

\footnote{A similar analysis has been developed independently for English wh-ever and Greek wh-dhîpote by Gianakidou and Cheng (this volume).}
take `mo` itself to be an i-sum forming operator, taking a set as its argument and yielding (a singleton set consisting of) the i-sum of the individuals that comprise that set. The revised interpretation of `mo` and the interpretation of the distributive operator are given in (9).

\[
(9) \quad a. \quad \llbracket \alpha \cdot \Mo \rrbracket^\iota \equiv \{ \Sigma \left( \llbracket \alpha \rrbracket^\iota \right) \} \quad (\Sigma \text{ forms i-sums from a set of individuals})^7 \\
b. \quad \llbracket \Op_{\text{dist.-i}} \rrbracket^\iota \equiv \{ \lambda x \lambda P \lambda w. [\forall x' \in x] (P(x')(w') = 1) \}
\]

Examples of basic interpretations of the types assumed for singular referential expressions, moPs and plural expressions are summarized below.

**Individuals:** \{ j \}, \{ b \}, \{ s \} \quad \text{(names, singular DPs)}

**I-sums:** \{ j \oplus b \}, \{ j \oplus s \}, \{ b \oplus s \}, \{ j \oplus b \oplus s \} \quad \text{(mo-phrases)}

**Groups:** \{ \uparrow (j \oplus b) \}, \{ \uparrow (j \oplus s) \}, \{ \uparrow (b \oplus s) \}, \{ \uparrow (j \oplus b \oplus s) \} \quad \text{(plurals)}

With the modifications given above to K&S's analysis, explaining the quantificational variability effect becomes straightforward. For the ambiguity introduced by adverbs of quantification, it suffices to treat `MOST` as quantifying over atomic parts of its restrictive clause rather than as binding a variable free within its scope. Since a moP denotes (a singleton set consisting of) an i-sum, it has an atomic part-whole structure and hence is the kind of expression that can readily constitute the restrictive clause of `MOST`. The ambiguity witnessed in (5) can then be analyzed as in (10), where \( p_a \) is shorthand for the interpretation of the papers that a wrote.

\[
(10) \quad a. \quad \llbracket \llbracket \text{Dare-ga kaita ronbun} \ D_{\text{def.-mo}} \ \Op_{\text{dist.-i}} \ \llbracket t_i \text{ taietei [ shuppan sareta]} \rrbracket \rrbracket^\iota^\iota^\iota
\]

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6 The idea of separating the quantificational force off from `mo` was proposed already in Nishigauchi (1986). However, Nishigauchi proposed deriving the universal quantificational interpretation of a moP from a covert adverb of quantification rather than from the distributive operator needed independently for plural interpretation. Though such an approach can be made to work out technically, we prefer to minimize the number of covert universally quantifying operators posited in the grammar, sticking with that independently required for interpreting plurals. For a full account of the interpretation of plurals and their relation to moPs, see Tancredi and Yamashina (in progress).

7 Though we analyze moP as semantically denoting an i-sum, we do not take moP to be a standard plural expression. For reasons argued at length in Yamashina and Tancredi (forthcoming) but not repeated here, a distinction needs to be made between true plurals, which give rise to cumulative and collective interpretations, and moPs which do not. We account for this distinction in our forthcoming paper by analyzing true plurals as denoting groups rather than i-sums by default, an analysis we assume here as well.
\[= \left[ O_{\text{Pub}} \left( mo \ (\text{the papers that who wrote}) \right) \ (\text{MOST} (x) \ (\text{was-published})) \right]^{w^g}\]
\[\{ \left[ \forall x \ \Pi p_a \oplus p_b \oplus \ldots \oplus p_n \right] \ (\text{Most} y \ x \ (\text{w-as-published (y)}) \} \]
\[= 1 \ \text{iff most of the papers } a \ \text{wrote were published, most of the papers } b \ \text{wrote were published, etc.}\]

b. \[\left[ \left[ [ \text{Dare-ga kaita ronbun } D_{\text{def}-mo} \ ] \ \text{taitei [ shuppan sareta ]} \right] \right]^{w^g}\]
\[= \left[ \left[ \text{MOST} (mo \ (\text{the papers that who wrote})) \ (\text{was-published}) \right]^{w^g}\]
\[\{ \left[ \text{MOST} x \ \Pi p_a \oplus p_b \oplus \ldots \oplus p_n \right] \ (\text{was-published (x)}) \}\]
\[= 1 \ \text{iff most of the members of the following set were published:}\]
\[\{ \text{the papers } a \ \text{wrote, the papers } b \ \text{wrote, } \ldots \} \]

(10a) is equivalent to the interpretation generated by K&S. Under this interpretation, the sentence will be true just in case for each person who wrote papers, most of their papers got published. It is thus true in the situation depicted in (6a) and false in the situation depicted in (6b). (10b) is an interpretation not generated by K&S. It is true just in case most people who wrote papers are such that all of their papers were published. On this interpretation, the sentence in (5) is false in situation (6a) and true in situation (6b), accounting for the intuition that (5) can be true in either situation in (6).

5 Problems for Indefinites
We are now ready to turn to the problem posed by indefinites. As Ohno (1989) has shown, it is possible for the DP to which \( mo \) is adjoined to be given an indefinite interpretation, as illustrated in (11).\(^9\)

\[\text{(11) } (\text{Kono mise-de-wa,} \text{dono-kuni-de} \ \text{shuppan-sareta hon-D}\text{ind}-mo \ \text{utte-iru}}\]
\[\text{(This store-at-Top) which-country-at publish-Pass-past book-D-mo sell-Asp}\]
\["\text{In this store, a book published in whatever country is sold."}\]

In this sentence, the DP is preferentially indefinite (singular or plural), and the moP distributed. The question that this example poses and which will concern us for the remainder of the paper is how such an indefinite interpretation can be formally generated.

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\(^8\) The second lines in (10a) and (10b) are included for expository purposes only, and are not intended as essential steps in the derivations of the final interpretations.

\(^9\) The example given here is from Ohno, and is one of few examples of a \( \text{wh-mo} \) DP that readily admits of an indefinite interpretation. Why such an interpretation is not more readily available is a problem that we will have to put off for future investigation.
To see why this example is problematic, consider first an attempt to analyze the indefinite as a generalized existential quantifier over individuals. Given the Hamblin semantics assumed, the interpretation of the indefinite DP under such an interpretation is (12).

\[ \{ \varphi : [\exists x: \text{country}(x)] (\varphi = \lambda P \exists y (y \text{ is a book published in } x \& P(y))) \}^{10} \]

This is the set of all generalized existential quantifier interpretations that can be generated from the DP *a book published in* \(x\) by substituting different countries for \(x\). Our assumption that *mo* is an i-sum forming operator, however, leads to difficulties when it comes to interpreting the moP in (11). Syntactically, there are two general options that could be considered for where to interpret the existential DP vis-à-vis *mo*: it could be interpreted in-situ, i.e. as a sister to *mo*, or it can be raised from its overt position to a position outside of *mo*. This latter option can furthermore be spelled out in at least two ways. If the movement leaves behind a trace as assumed within the Principles and Parameters framework, then the existential DP will be interpreted entirely outside the scope of *mo*. Alternatively, if the movement is an instance of copying with complementary deletion applying at LF, as has been argued within the minimalist framework by Chomsky (1995) among others, then the existential operator will be interpreted outside the scope of *mo* and its restrictive clause will be interpreted in its overt position. Unfortunately, as we will see directly, none of these options is viable.

The most plausible of these options is the first one. It involves leaving the indefinite entirely within the scope of *mo*. Since *mo* forms an i-sum from its sister, this approach would require allowing i-sum formation to apply to generalized quantifiers as well as to individuals. There is no technical hurdle to implementing this idea, and the semantics produced do give the correct truth conditions. Under our present set of assumptions such an analysis would lead to an interpretation like (13) for (11).

\[ \{ [\forall Q \Pi \Sigma (\{ \varphi : [\exists x: \text{country}(x)] (\varphi = \lambda P \exists y: y \text{ is a book published in } x \& P(y))) \}] (Q (\lambda y. \text{is-sold (}y, \text{here})) ) \} \]

With the truth conditions in (13), (11) will be true just in case every one of the indefinite descriptions given in (12) applies truthfully to the predicate *is sold (here)*. The problem with this approach is that it opens the door for any other generalized

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10 Here and throughout, we ignore worlds where they are not directly relevant to the point at hand.
quantifiers to appear in this same construction. As suggested by (14), however, strong quantifiers are uniformly blocked from this construction.11

(14) Dono-kuni-de shuppan-sareta (*subete- / *hotondo-no) hon-mo utte-iru
    /&-at publish-Past every / most-GEN book-mo sell-Asp

"Every book / Most books published in whatever country is / are sold (here)."
Adopting a generalized quantifier analysis of indefinites would then require stipulating that only weak quantifiers can occur in the wh-mo construction, constituting a failure to provide a fully explanatory account of the properties of this construction.

The movement alternatives suggested above fare much worse than the non-movement alternative just considered. For the case in which the entire DP is raised outside of mo, the resulting semantics for the sentence is (15).

(15) \( \{p : (\exists x : \text{country}(x)) \ (p = \lambda w'. \exists y (y \text{ is a book published in } x \text{ in } w' \ & [\forall x \Pi \Sigma(\{ y \}) \text{ is-sold } (x,\text{here},w'))) \} \}

Here, the Hamblin set generated by the wh-expression gives rise to multiple existential quantifier interpretations as in the non-raising analysis. However, in the present case this set is raised outside the scope of mo, and so cannot be operated on by mo. Even overlooking the fact that i-sum formation is being applied to a singular variable, this leads to problems since (15) constitutes a set of propositions, not a single proposition as desired. In particular, it is the set of all propositions that can be generated from A book published in x is sold (here) by substituting a country for x. While we could generate correct truth conditions in this particular example by taking (15) to be true just in case every proposition in the set is true, this would amount to a claim that wh-expressions in general can be given a universal quantification interpretation by being interpreted outside the scope of an operator like mo (or the question marker ka). Such a flouting of the Hamblin semantics for wh-expressions is clearly undesirable.

The copy plus complementary deletion approach to movement has not yet been given a widely accepted semantics, and so it is unclear what the interpretation of (11). However, to avoid the problem that arose in (15) from generating the wh-alternatives outside the scope of mo, it is clear that the Hamblin set generated by the indefinite dono-kuni (which country) must remain within the scope of mo. Furthermore, to avoid

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11 The analysis of K&S does not allow mo to operate over quantifiers, and in this respect represents an improvement over Shimoyama (2001). However, K&S also fail to address the question of how to interpret indefinites, a problem that Shimoyama (2001) was very much concerned with.
the problem of allowing i-sum formation to apply to generalized quantifiers, it is necessary to interpret the quantificational part outside the scope of mo. This suggests an interpretation along the following lines.

(16) \[ \forall y \left( \exists x \in \Sigma (z: [\exists x: \text{country}(x)] (z \text{ is a book published in } x) \& z = y) \right) \]

(is-sold (x,here))

The interpretation in (16) is perfectly coherent. However, it is equally incorrect for the sentence under consideration. With (16) for truth conditions, the sentence should be true provided only that a single book from a single country is sold in the store in question, even if there are multiple countries under discussion in which books have been published and from which countries no books are sold in the store. Under such a situation, however, the sentence in (11) is clearly false. In the absence of a clear semantic working out of the copy plus complementary deletion analysis of movement it is hard to claim to have ruled out a generalized existential quantifier analysis of indefinites. However, the most straightforward way of working out such an analysis clearly does not work, and no obvious alternatives suggest themselves.

The above considerations strongly mitigate against analyzing the DP in (11) as an existential quantifier over individuals. Reinhart (1997) has already argued convincingly and on separate grounds, however, that a generalized existential quantifier analysis of indefinites is insufficient. She proposes as an alternative to analyze indefinites as involving quantification not over individuals but rather over choice functions. However, as we will see, adopting Reinhart's analysis without modification does not make it possible to overcome our present difficulties without introducing separate problems.

Adapting Reinhart's choice function analysis so that it fits with the Hamblin semantics of K&S, the indefinite determiner \( D_{\text{under}} \) should be analyzed as \( \{ \lambda P.f(P) \} \)\[^{12} \], i.e. as a function from a one place predicate \( P \)\[^{13} \) to the result of applying a choice function \( f \) to \( P \). In (11), the argument of the indefinite determiner will be a set of 1-place

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\[^{12}\text{A more plausible analysis would take the determiner as combining first with its NP sister and then separately with the relative clause, having the interpretation } \{ \lambda P.\exists Q.f(\lambda x.P(x) = Q(x) = 1) \}. \text{ This complication would only add clutter to the exposition, however, without contributing anything of substance to the discussion, and so we adopt the simplified analysis presented in the text in which the NP and it's relative clause are implicitly assumed to form a single constituent.}\]

\[^{13}\text{We use functions instead of sets as the denotation of one place predicates in order to clearly distinguish them from the Hamblin alternatives generated by wh-expressions.}\]
predicates, specifically the set given in (17a). K&S's Hamblin semantics will then combine this set with the determiner interpretation to produce the set in (17b).

(17)  
   a. \( \{ \lambda x. x \text{ is a book published in } y : \text{country}(y) \} \)  
   b. \( \{ f(\lambda x. x \text{ is a book published in } y) : \text{country}(y) \} \) 

This is a set that consists of one book published in \( y \) for each \( \text{country}(y) \), with the book in question selected by the choice function \( f \). The only question that remains is where to locate the existential quantifier binding the choice function. It is here, however, that combining K&S's Hamblin semantics with Reinhart's choice function analysis runs into difficulties. To see why, consider the interpretation of the sentence minus the existential quantifier given in (18). Since an existential quantifier is typically taken to require sentential (or propositional) scope, the two obvious candidate positions for locating the binder of the choice function variable are those given in (19).

(18)  
   \[ [[\text{dono-kuni-de shuppan-sareta hon-D-mo utte-iru}]]^f \]  
   \[ \forall x \Pi \Sigma(\{f(\lambda x. x \text{ is a book published in } y) : \text{country}(y) \} ) \] (is-sold \( x \) )  

(19)  
   a. \[ \forall x \Pi \Sigma(\{f(\lambda x. x \text{ is a book published in } y) : \text{country}(y) \} ) \] \( \exists f \) (is-sold \( x, \text{here} \) )  
   b. \( \exists f \ [\forall x \Pi \Sigma(\{f(\lambda x. x \text{ is a book published in } y) : \text{country}(y) \} ) \] (is-sold \( x, \text{here} \) ) 

However, neither of these options is adequate. For (19a) this is obvious, since \( f \) is free and the existential quantification vacuous. (19b), in contrast, at least has the appearance of giving the correct truth conditions. According to (19b), (11) will be true just in case there is some choice function \( f \) such that for every book \( x \) that can be generated by applying \( f \) to the set of books published in \( y \) for some \( \text{country}(y) \), \( x \) is sold in the store. Since no two countries can plausibly be expected to publish exactly the same books, and since the book selected by the choice function \( f \) depends on the identity of the set of books to which \( f \) is applied, there is no problem finding an appropriate choice function that will pick out one book for each country.

While the analysis in (19b) appears to give the right truth conditions for (11), the analysis cannot be maintained in general. The problem with the analysis lies in the nature of choice functions. For a given set \( S \), any choice function \( f \) will select at most one element of \( S \). Moreover, the element selected will be the same regardless of how \( S \) is characterized. Since pragmatic considerations blocked the possibility of generating the same set of books for any two countries in (11), this aspect of choice functions did not cause any problems in that example. However, if we modify our
example in such a way that a single set is operated on multiple times, we find that the
results produced clash with observation. To see this, consider the following situation.
In a class of 15, each student wrote one paper. During the class, the students were put
into groups of 5 and then circulated their papers for the other students in their group to
read. Within each of the three groups, everyone read everyone else's paper, and
everyone criticized a different one. In such a situation, the sentence in (20) is
intuitively true.

(20)  \textit{(Minna-ga daitai yonda ronbun-o ki-ni-itta ga,}
\textit{Everybody mostly liked the papers they read, but)}
dare-ga yonda ronbun-D-mo soitsu-hi hihan-sare-ta
who-NOM read paper he-DAT criticize-PASS-PAST
lit. A paper that whoever, read was criticized by him.,

[very roughly: Whoever read a paper criticized one.]

On the interpretation of interest here, the sentence entails that for each person who read
the papers in her group, there is a paper among them that she criticized. Thus each
person need only criticize one of the 5 papers that she read in order for the sentence to
be true. Now, however, consider what results from our combining K&S with Reinhart
as in (21).

(21)  $\exists f[\forall z \Sigma(f(\lambda x. \text{x is a paper that y read}): \text{person(y)})))]$ (criticized (that person, z))

Since within any of the groups the set of papers read does not differ from person to
person, the function $\lambda x. x \text{ is a paper that y read}$ will have the same extension for each of
5 individuals assigned to y. This in turn means that the result of applying a choice
function to this set, i.e. $f(\lambda x. x \text{ is a paper that y read})$, will also always be the same for
each of these 5 individuals substituted for y. The truth conditions in (21) then make
(20) true only if within each group every student criticized the same paper. As we
already observed, however, the sentence is true even if the papers criticized by each of
the students differ.

6 Intensionalizing Choice Functions
To overcome the problem posed by (20), we propose to intensionalize choice functions.
Recall that under our rendition of Reinhart's analysis a choice function applies to a one
place predicate and yields an individual that the predicate is true of. The problem we
ran into with (20) is that this analysis of choice functions cannot distinguish between
co-extensional predicates. The obvious solution to this problem is to have choice
functions apply to the intension of a predicate rather than to its extension. We do this by giving choice functions two arguments, an intensional 1-place predicate \( P \) and a world \( w \), and yielding an individual \( x \) such that \( P(x)(w) = 1 \). Choice functions are introduced by indefinite determiners and get bound by existential closure, as before. We give the interpretation of the indefinite determiner in (22).

\[
[D_{\text{indet}}]^w = \{ \lambda P. f(P)(w) \}
\]

This gives (24) as an interpretation (with respect to world \( w \)) for (20), repeated here as (23).

\[
\begin{align*}
\text{(23) Dare-ga yonda ronbun-D-mo soitsu-ni hihan-sare-ta} \\
\text{who-NOM read paper-D-mo he-DAT criticize-PASS-PAST}
\end{align*}
\]

\[
\begin{align*}
\text{(24) } & \exists f \{ \forall x \Pi \Sigma \{(f(\lambda x \lambda w'. \text{paper}(x,w') \& \text{read}(y,x,w'))(w) : \text{person}(y))\} \} \text{ (criticized} \\
& \text{that person},x)\}
\end{align*}
\]

The truth of (24) depends on the ability to select a function \( f \) which makes the universally quantified part of the sentence true. This function will need to select one paper for each person who reads papers. Even if two people, say John and Sue, read the same 5 papers, however, it does not follows that \( f \) will pick out the same paper for each of them. This is because co-extensionality does not guarantee co-intensionality. Indeed, though \( \text{paper that John read} \) and \( \text{paper that Sue read} \) are co-extensional predicates in this situation, they are not co-intensional. Returning to (24), since the individual selected by the choice function \( f \) depends on the intension of its predicational argument \( \lambda x \lambda w'. \text{paper}(x,w') \& \text{read}(y,x,w') \), and since this intension will differ for distinct values of \( y \), it follows that the individual paper selected by \( f \) can vary for different values of \( y \) as well, as needed. For each person \( y \), one paper is selected by \( f \). \( \Sigma \) then sums each of these papers, and the universal quantifier distributes over the sum. The sentence will be true, then, just in case there exists a choice function \( f \) such that for each person \( y \), the paper selected by \( f \) is such that \( y \) criticized it. This is consistent with our intuitions about the truth conditions of the sentence in (23) (= (20)).

For completeness, we need to check that the revisions made to Reinhart's analysis still capture the intended interpretation of Ohno's example in (11). For that we need only look at the intensionalized version of (19b) given in (25).

\[
\begin{align*}
\text{(25) } & \exists f \{ \forall x \Pi \Sigma \{(f(\lambda x \lambda w'. x \text{ is a book published in } y \text{ in } w')(w) : \text{country}(y)) \} \}
\end{align*}
\]

(is-sold (x,here))

It should be apparent by now, however, that the change made in our interpretation of choice functions is innocuous with respect to this example. The predicates that \( f \)
applied to in (19b) already differed in extension for different choices of \(y\). If the extensions of these predicates differ, however, then it follows that their intensions differ as well. It is thus guaranteed to be possible to find a choice function \(f\) which will choose a different book in (25) for each country.

7 Conclusion

In this paper, we argued that the semantic function of \(mo\) is not one of quantification, as argued in Kratzer and Shomoyama (2002), Shimoyama (2001) and von Stechow (1996), but rather one of i-sum formation. The universal quantification standardly associated with \(mo\) we analyze as coming from an optional distributive operator needed independently in the analysis of distributed plurals. This distribution of labor makes it possible to account for quantificational variability effects found when combining wh-\(mo\) DPs with adverbs of quantification such as \(taiteti\) (usually). The analysis we gave is an extension of the Hamblin semantics of K&S, and thus inherits the many positive aspects of that semantics.

We then went on to show that the resulting analysis does not fit well with current analyses of indefinites. In particular, it cannot be combined with a generalized quantifier analysis of indefinites, nor with an extensional choice function analysis such as that of Reinhart (1997). We showed, however, that a simple intensionalization of Reinhart's analysis can combine with the Hamblin semantics of K&S as revised, and that the resulting analysis gives the proper truth conditions for wh-\(mo\) indefinite DPs.

Appendix

Lexical Entries:

\[
[[\text{dare}]] = \{ x: \text{person}(x) \}
\]

\[
[[\text{dono}]] = \{ \lambda P. \{ x: P(x)(w) \} \}
\]

\[
[[\text{D}_{\text{def.sg.}}]] = \{ \lambda P\lambda Q. \sigma (\{ x: P(x) & Q(x) \}) \} \quad \text{[\(\sigma\) a supremum operator]}
\]

\[
[[\text{D}_{\text{def.pl.}}]] = \{ \lambda P\lambda Q. \uparrow \sigma (\{ x: *P(x) & *Q(x) \}) \} \quad \text{[*P the pluralization of P]}
\]

\[
[[\text{D}_{\text{ndef.sg.}}]] = \{ \lambda P. f(P)(w) \}
\]

\[
[[\text{D}_{\text{ndef.pl.}}]] = \{ \lambda P. f(*P)(w) \}
\]

\[
[[\text{\(-mo\)}]] = \{ \Sigma (\{ \alpha \}) \}
\]

\[
[[\text{Op dist}]] = \{ \lambda x \lambda P \lambda w. (\forall x' \Pi x) (P(x)(w)) \}
\]

\[
[[\text{taiteti}]] = \{ \lambda P \lambda x. [\text{most } x' \Pi x] (P(x')) \}
\]
Interpretation of (11)

(11) \([ [C_P]_{\text{moP}}[D_P]_{\text{PP}} \text{dono-kuni-de} \text{ shuppan-sareta hon } D_{\text{def}} \text{ mo] utte-iru} ] ]^g\)

\([D_P]_{\text{PP}}^{\text{rw}} = \{ x: \text{country}(x,w) \} \)

\([D_P]_{\text{PP}}^{\text{rw}} = \{ f (\lambda y \lambda w. \text{book}(y,w') & \text{published-in}(y,x,w')) : \text{country}(x,w) \} \)

\([\text{moP}]_{\text{PP}}^{\text{rw}} = \{ \Sigma(\{ f (\lambda y \lambda w. \text{book}(y,w') & \text{published-in}(y,x,w')) : \text{country}(x,w) \} ) \} \)

\([D_P]_{\text{PP}}^{\text{rw}} = \exists f (\forall x \Sigma(\{ f (\lambda y \lambda w. \text{book}(y,w') & \text{published-in}(y,x,w')) : \text{country}(x,w) \} ) ) \text{ (is-sold (x,here))} \)

Two interpretations of (5)

(5) \([D_P]_{\text{CP}} \text{ Dare-ga kai-ta} \text{ ronbun]-mo taitei} \text{ shuppan-sareta} \)

who-OM \text{ write-past paper-mo usually were-published}

The papers that whoever wrote were usually published

Every (person) > Most (papers)

a. \([C_P]_{\text{moP}}[D_P]_{\text{CP}} \text{ Dare-ga} \text{ t, kai-ta} \text{ ronbun}_{\text{de,pl}} \text{-mo] Op}_{\text{dis}} \text{[VP taitei shuppan-sareta]} \]

b. \([D_P]_{\text{PP}} = \{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} \)

\([\text{moP} \text{ Op}_{\text{dis}}^{\text{vp}}] = \{ \lambda P \lambda x. [\forall x' \Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} ) ) (P(x)(w)) \} \)

\([\text{VP}] = \{ \lambda x \lambda w. [\text{most } x' \Pi x] (\text{published}(x',w)) \} \)

\([\Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} ) ](x,w) \}

\(\{ \lambda w. [\forall z \Pi \Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} )]

\(\{ \text{most } z' \Pi z \} (\text{published}(x',w)) \} \)

Most (people) > The (papers)

a. \([C_P]_{\text{moP}}[D_P]_{\text{CP}} \text{ Dare-ga} \text{ t, kai-ta} \text{ ronbun}_{\text{de,pl}} \text{-mo] [VP taitei shuppan-sareta]} \]

b. \([\Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} )]

\([\Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} )]

\(\{ \lambda w. [\text{most } x' \Pi \Sigma(\{ \uparrow \sigma (\{ y: *\text{paper}(y) & \text{wrote}(x,y) \} ) : \text{person}(x) \} )]

\(\{ \text{was published}(x',w) \} \}

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