The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers in Japanese

Hisashi Morita
Aichi Prefectural University

In Japanese a certain kind of phrase, which Kuroda (1965) calls "indeterminate", can function as a wh-phrase, existential quantifier or universal quantifier depending on context and the use of particles. I argue that "indeterminates" are contrastive-focused, and that the meanings of existential and universal quantifiers are made of (in)finite application of disjunction ("ka") and conjunction ("mo") respectively. Furthermore, I argue that the same disjunction, "ka", is used in wh-questions and the meaning of wh-questions is derived with disjunction while retaining Hamblin's (1973) claim that the meaning of wh-questions is a set of propositions.

Areas of interest: indeterminates, wh-questions, disjunction, choice function

1 Introduction

It has been noted that existential quantifiers and wh-phrases are related (cf. Kartunnen (1977)). For example, in Japanese, an existential quantifier is "dare-ka" ("someone") whereas a wh-phrase is "dare" ("who") (cf. Kuroda (1965), Hoji (1985), Nishigauchi (1990) among others). Furthermore, wh-questions end with a wh-question particle, "ka". In other words, depending on the position of "ka", the common part, "dare", can serve either as a wh-phrase ("who") or as an existential quantifier ("someone"). Consider the following sentences:

(1) Dare-ga kimasita ka?
who-NOM came Q 'Who came?'

(2) Dare-ka-ga kimasita.
somebody-NOM came
'Somebody came.'

(3) John-ka Mary-ga kimasita.
- or -Nom came
'John or Mary came.'

(1) is a wh-question and I assume that "ka" is in C. In (2), "ka" is attached to the wh-phrase, which turns into an existential quantifier. (3) shows that "ka" itself functions as disjunction. Here I assume that "ka" in (1), (2), and (3) all denote disjunction because of the following reasons. The first reason is that it is a common phenomenon in natural languages that homophonous elements to disjunction particles are used as question particles (e.g. Mayalam, Okinawan, Sinhala, Thai, and many others). We find such evidence even in English. Consider the following sentence:
(4) (from Higginbotham (1991))
Would you like coffee or tea?

Suppose a stewardess says (4) to you. Then you won’t say “yes” or “no” because (4) is not a Yes/No question. Rather it is more like a wh-question in that she is asking what you like to drink. Again this shows that the use of disjunction to ask wh-questions is quite common in natural languages as in (1). Furthermore, as we will see later, sentences like (2) may represent wh-questions rather than sentences with existential quantifiers in Old Japanese. This fact suggests that “ka” in (1) and (2) may be of the same kind.

The second reason for regarding the three kinds of “ka” as disjunction is that “ka” which licenses existential quantifiers as in (2) can function as disjunction at the same time under certain circumstances. Compare the following sentences:

(5) John-ka Mary-ka-ga kita (cf. (3))  
-or   -or -Nom came  
‘John or Mary came.’

what-Acc bought person-KA what-Acc sold person-KA-Nom came  
‘A person who bought something or a person who sold something came.’

As in (5), it is possible to attach the disjunction operator “ka” not only to the end of the first NP but also to the end of the second NP. In (6), “ka” has two functions. First, it licenses existential quantifiers by binding wh-phrases. Secondly, it connects the two NPs with disjunction. Considering these reasons, it seems natural to propose that “ka” in existential quantifiers, and hence, “ka” in wh-questions denote disjunction in Japanese.

Next examine the following example:

(7) Dare-mo-ga kimasita.  
everybody-NOM came  
‘Everybody came.’

If “ka” in (2) is replaced with “mo”, a universal quantifier is generated as in (7). Thus those three, that is, (1), (2), and (7), look quite similar to each other syntactically. This relationship is not limited to ‘people’ as follows:

(8) wh-phrases    existential quantifiers    universal quantifier (or NPI)
  nani (‘what’)   nani-ka (‘something’)   nani-mo (‘anything’)
  itu (‘when’)    itu-ka (‘ sometime’)    itu-mo (‘always’)
  doko (‘where’)  doko-ka (‘ somewhere’)  doko-mo (‘ everywhere’)
  naze (‘why’)    naze-ka (‘for some reason’)  

Coming back to the contrast of the three sentences, (1), (2), and (7), the first two sentences are particularly close in terms of the kinds of lexical items employed. Since the only difference seems to be the position of “ka” in (1) and (2), both of which denote disjunction, the difference
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers

in meaning between sentences with wh-phrases and sentences with existential quantifiers should be explained in terms of the difference of disjunction scope. However, the semantic representations of the two look considerably different, which seems to suggest that the two representations differ not only in terms of scope but also due to something else. Traditionally these are semantically represented as follows:

\[ (9) \quad \lambda p \exists x [\text{people}'(x) \land p = \text{came}'(x)] \text{ (for (1))} \]
\[ (10) \quad \exists x [\text{people}'(x) \land \text{came}'(x)] \text{ (for (2))} \]

Following Hamblin (1973) and Karttunen (1977), I assume that the meaning of wh-questions is a set of possible propositions and this is expressed as in (9). For the existential quantifier, the operator, '∃', is employed as in (10). If we compare these two representations, there seems to be a big gap between the two. Comparing to the sentence with the existential quantifier, the semantics of the wh-question seems to be much more complex: lambda abstraction, a new variable (p), '=', and the intensional operator are additionally employed in (9). What is more, there is no disjunction employed in either (9) or (10) though "ka" is used in both syntactic representations (cf. (1) and (2)) and is likely to denote disjunction there as well. I would like to show that the meanings of existential quantifiers and wh-phrases are closely related if different representations are adopted.

There are several attempts to seek the semantic relationship among wh-phrases, existential quantifiers and universal quantifiers in Japanese. Below I will review a few proposals: Fukushima (1990), Ramchand (1997), and Hagstrom (1998). Then I will argue that Ramchand's (1997) proposal is the most suitable to explain the relationship and will present a formalised account to apply her insight to Japanese data.

2 Fukushima (1990)

Following Kuroda (1965), Fukushima (1990) notes that there are morphological similarities among wh-phrases, existential quantifiers, and universal quantifiers in Japanese. Since his framework, being HPSG, does not assume the existence of transformation, and hence, is incompatible with the present framework, I only discuss Fukushima's essential ideas. Fukushima argues that the semantics of, for example, "dare" ('who'), "dare-ka" ('someone'), and "dare-mo" ('everyone') are defined as follows:

\[ (11) \quad \text{"dare" ('who')} \quad \lambda Q(\lambda x)[\text{person}'(x) \land Q(x)] \]
\[ (12) \quad \text{"dare-ka" ('someone')} \quad \lambda Q\exists x[\text{person}'(x) \land Q(x)] \]
\[ (13) \quad \text{"dare-mo" ('everyone')} \quad \lambda Q\forall x[\text{people}'(x) \rightarrow Q(x)] \]
If we apply these to (1), (2), and (7), the following representations are derived:

\[
\begin{align*}
(14) \quad & (\text{for } (1)) \\
& (\lambda x)[\text{person}'(x) \& \text{came}'(x)] \\
(15) \quad & (\text{for } (2)) \\
& \exists x[\text{person}'(x) \& \text{came}'(x)] \\
(16) \quad & (\text{for } (7)) \\
& \forall x[\text{people}'(x) \rightarrow \text{came}'(x)] \\
\end{align*}
\]

Note that Fukushima’s (1990) representation of the wh-question, e.g. (14), is not a standard view. He argues that the meaning of wh-questions is an incomplete sentence. By presenting an incomplete proposition, a hearer is required to fill the gap. Thus, the hearer of (1) must fill the variable of ‘x’ and this counts as an answer in (14). There are a few problems with Fukushima’s (1990) approach. First, it is assumed in the literature that the meaning of wh-questions is not an incomplete proposition but a set of propositions. The reason is as follows. Compare the following two questions and possible answers.

\[
\begin{align*}
(17) \quad & \text{Q: What did you do yesterday?} \\
& A: \text{I went out.} \\
& A: \text{I had a meal.} \\
& A: \text{I worked all day.} \\
& \ldots \\
(18) \quad & \text{Q: What did you eat yesterday?} \\
& A: \text{a sandwich} \\
& A: \text{French} \\
& A: \text{Chinese} \\
& \ldots \\
\end{align*}
\]

As a matter of fact, there is an entailment relationship between the possible answers of (17) and of (18): there is always a possible answer in (17) that one possible answer in (18) entails. For example, a possible answer to (18), ‘(that I had) Chinese (yesterday)’, entails a possible answer to (17), ‘(that) I had a meal (yesterday)’. Thus, we find that possible answers for wh-questions are propositions (though it may not look so in (18)). But if Fukushima’s (1990) view is correct, the entailment relationship is unexpected. This is because possible answers can be entities under his framework. For example, the possible answers of (18) are the set of edible objects or kinds, and these cannot participate in the entailment relationship because they do not have truth-value. Accordingly, it is assumed in the literature that the meaning of wh-questions is not an incomplete proposition but a set of propositions. This may pose a problem to Fukushima’s view.

The second problem with Fukushima (1990) is that the important insight mentioned at the beginning of this paper is not reflected. In other words, the disjunction function of “ka” is not existent anywhere. What is worse, even the existential operator does not appear in (14). This makes us wonder what the function of “ka” is in wh-questions and in existential quantifiers. This question remains to be answered if we adopt his approach.

Relevant to the second problem, it is not clear how the relation between (15) and (16) is reflected in the syntax. As far as the surface structures are concerned, the positions of “ka” and
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers

“mo” are the same. By changing “ka” into “mo” in the same position, the lexical items turns from an existential quantifier into a universal quantifier. However, if (15) and (16) are correct semantic representations for (2) and (7), the correlation between syntax and semantics is not clear. (The same criticism applies to Shimoyama (1999), which I will not discuss in this paper.)

3 Ramchand (1997)

Ramchand (1997) examines the semantics of wh-phrases, existential quantifiers, NPIs, and free choice ‘any’ in Bengali, which shows a close morphological relationship among them as in Japanese. Some data are repeated below:

(19) (from Ramchand (1997))

<table>
<thead>
<tr>
<th>wh-phrases</th>
<th>existential quantifiers</th>
<th>free choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>ke ('who-Nom')</td>
<td>ke-o ('someone')</td>
<td>je ke-o ('anyone')</td>
</tr>
<tr>
<td>kotha-e ('where-Loc')</td>
<td>kotha-o ('somewhere')</td>
<td>je kotha-o ('anywhere')</td>
</tr>
</tbody>
</table>

As in Japanese, wh-phrases are common parts. Ramchand calls them “k-words” because wh-phrases start with “k” in Bengali. By adding “o”, which she calls “an emphatic particle”, “k-words” function as existential quantifiers or NPIs depending on contexts. If “je” is further added, they function as free choice. Ramchand discusses the status of “k-words” and argues that it is implausible to regard them as quantifiers. It seems clear that “k-words” inherently do not have quantificational force, and hence, are not quantifiers because they seem to change their quantificational force depending on particles surrounding them. She also claims that “k-words” are not indefinites because of two reasons. First, “k-words” do not show variable quantificational force with adverbs unlike indefinites. Contrast the following examples:

(20) (from Ramchand (1997))

Beral-er sObhabOto lej thake
Cat-Gen usually tail remain-PRES3RD
‘A cat usually has a tail.’

(21) (from Ramchand (1997))

*Kon-o Beral-er sObhabOto lej thake
what-EMPH cat-Gen usually tail remain-PRES3RD
‘A cat usually has a tail.’

The fact that “k-words” do not exhibit variable quantificational force shows that “k-words” are not free variables, and hence, indefinites. The second reason why “k-words” are not indefinites is that “k-words” cannot be bound by existential closure to provide specific indefinite readings. Consider the following English discourse, first:

(22) (from Ramchand (1997))

Yesterday, a student came to see you. She’s a good friend of mine.
Ramchand then gives the following Bengali example:

(23) (from Ramchand (1997))
Goto kal kon-o akta student toma-ke dekhte elo
‘Yesterday which-EMPH one-Def student you-Acc to see came’

‘Yesterday a student came to see you.’

Ramchand (1997) argues that (23) itself is a possible sentence, but it cannot be followed by ‘she’s a good friend of mine’, unlike (22). This is because, she claims, a k-word “may only be used in a sentence...in Bengali if the referent is unknown, non-specific, and with the implication that the actual referent is completely irrelevant to the discourse.” Therefore, “k-words” are not indefinites.

Ramchand’s discussion of Bengali parallels with Japanese data so far. Following Kuroda (1965), I call the common parts between wh-phrases, existential quantifiers, and universal quantifiers in Japanese indeterminates. Indeterminates are unlikely to be quantifiers. Japanese cases are even clearer. The quantificational force of indeterminates seems to be determined by particles attached to them such as “ka” and “mo” (cf. (8)). Thus, indeterminates themselves do not seem to have quantificational force inherently. What is more, indeterminates do not show variable quantificational force with adverbs as follows:

(24) *Dono neko-ga taitei sippo-o motteimasu
Ind cat-Nom usually tail-Acc has
‘A cat usually has a tail.’

Nishigauchi (1990), however, argues that indeterminates are indefinites and presents the following examples to support his claim:

(25) (from Nishigauchi (1990: 171))
[Dono gakusei-ga kaita] ronbun-ni-mo taitei omosiroi koto-ga kaite atta.
Ind student-Nom wrote paper-Dat-MO usually interesting thing-Nom written was
‘For most x, y, x a student, y a paper that x wrote, something interesting was written in y.’

(26) (from Nishigauchi (1990: 166))
Dare-ga kite-mo, boku-wa taitei au.
Ind-Nom come-MO I-Top usually meet
‘For all x, x a person, if x comes, I usually meet x.
or ‘I meet most people who come over.’

As (25) and (26) show, the meanings of the indeterminates, “dono gakusei” and “dare”, are affected by the adverb “taitei” (’usually’). Thus, these data may support the view that indeterminates are indefinites as Nishigauchi (1990) argues. However, if we examine the data carefully, the indeterminates appear to have been given quantificational force by “mo” before being affected by the adverb, “taitei”. That is, “mo” turns them into universal quantifiers and then the adverb makes them ‘most’-like interpretations. This suggestion seems to be the case and is further illustrated as follows:
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers 27

(27) [Dare-mo-ga taitei ikitagaru] omise
Ind-MO-Nom usually want.to.go shop
‘a shop where everybody usually wants to go.’
or ‘a shop where almost everybody wants to go.’

(27) clearly shows that the universal quantifier, “dare-mo”, is affected by the adverb, “taitei”, as the meaning of “everybody” is modified by “almost” in the English translation. It is possible to argue that “taitei” can mean ‘almost’ as well as ‘usually’ in Japanese. This seems to be the case. Examine the following data:

(28) Ouchi-ga taitei dekiagatta.
house-Nom almost completed.
‘The house is almost completed.’

If the argument here is correct, what the adverb affects is not a force-less object but a universal quantifier. Hence, Nishigauchi’s data above do not support the view that indeterminates are indefinites.

The last reason why indeterminates are not indefinites is the following. It is difficult to use an existential quantifier which is made of an indeterminate and “ka”, when its identity is known and specific in Japanese as follows:

(29) *kinoo dare-ka-ga anata-ni aini kimasita.
yesterday Ind-KA-Nom you-Dat to.see came
kanojo-wa watasi-no tomodachi desu.
she-Top I-Gen friend Cop
‘Yesterday someone came to see you. She is a friend of mine.’

All of these pieces of evidence show that indeterminates are neither quantifiers nor indefinites in Japanese as in “k-words” in Bengali.

Before explaining Ramchand’s proposal further, let me introduce Rooth (1985, 1996). He discusses the semantics of contrastive-focused phrases. Compare the following sentences:

(30) John only introduced Mary to [Bill]F.
(31) John only introduced [Mary]F to Bill.

“Bill” is focused in (30) and “Mary” is focused in (31). The focused phrases interact with “only”, so that we may have different truth-value in (30) and (31) under certain circumstance. For example, if John introduced Mary and George to Bill, (30) is true, but (31) is false. To explain the semantic difference in a case such as this, Rooth (1985, 1996) argues that focused phrases provide a set of alternatives. In the current examples, if “Bill” or “Mary” is focused, it generates a set of people, {Bill, George, Rachel, …}. If each element of this set is inserted into the slot where focus is placed, a set of propositions is created. The semantic representation of (31), for example, is as follows, where only the first proposition is true:
Now it is clear why (31) is a false statement if John introduced Mary and George to Bill. This is because the only first proposition in (32) is true and the rest of propositions are all false. Since focused phrases generate a set of alternatives for contrasting, they are called contrastive-foci.

On the basis of Rooth’s analysis of contrastive-focused phrases, Ramchand (1997) then argues that “k-words” (as well as indeterminates in Japanese) are contrastive-focused, and hence, provide a set of alternatives. I will depart from the Bengali data from now on. I will apply her analysis to the Japanese data introduced above. If Ramchand (1997) is correct in saying that indeterminates are contrastive-focused, the meanings of indeterminates are represented as follows:

(33) dare (‘who’) → a₁, a₂, a₃, .... where a is human.
nani (‘what’) → b₁, b₂, b₃, .... where b is a thing.
itu (‘when’) → c₁, c₂, c₃, .... where c is time.
and so on.

Wh-phrases are generally phonologically stressed in natural languages. Indeterminates are focused in Japanese. In the literature two kinds of focused phrases are discussed: information focus and contrastive focus. Echepare (1996), for example, notes that there are two kinds of overt focus movement in Basque: information focus and contrastive focus. Information focus movement fronts phrases which are new information, while contrastive-focus is quite distinct from the new/old distinction (though the two often overlap). Contrastive-focused phrases, which, according to Rooth (1985, 1996), provide a set of alternatives, are also raised in Basque.

Suppose that Ramchand (1997) is correct in saying that indeterminates (or “k-words”) are contrastive-focused. Then, “dare” is contrastive-focused, and hence, provides a set of people. Similarly, “nani” generates a set of things while “itu” generates a set of time. If disjunction is added to the set, it is possible to express the meaning of existential quantifiers, which may suggest that disjunction is more primitive than an existential quantifier. Similarly, if conjunction is added to the set, it is possible to express the meaning of universal quantifiers. Examine (1), (2), and (7) again, which are repeated below:

(1) **Dare-ga** kimasita ka?
Ind-NOM came Q
‘Who came?’

(2) **Dare-ka-ga** kimasita.
Ind-KA-Nom came
‘Somebody came.’

(7) **Dare-mo-ga** kimasita.
Ind-MO-Nom came
‘Everybody came.’
Following Ramchand (1997), the semantic representations of (1), (2), and (7) are the following:

(34) (for (1))
{ a₁ came, a₂ came, a₃ came, ... } where a is human

(35) (for (2))
{ a₁ or a₂ or a₃ or ... } came. where a is human

(36) (for (7))
{ a₁ & a₂ & a₃ & ... } came. where a is human

As I have shown above, "ka" itself denotes disjunction (cf. (3)), so (35), where the set of people is connected with disjunction, is a straightforward case. In other words, the meaning of "dareka", which has been thought to be an existential quantifier, is easily represented with the (in)finite application of disjunction to the set of people (see also Jayaseelan (2001) for the same conclusion). What is more, "mo" denotes conjunction in Japanese as in (37):

(37) Ken-mo Mary-mo kita.
   -and -and came
   'Ken and Mary came.'

Thus, (36) is also a straightforward case. That is to say, the meaning of "dare-mo", which has been thought to be a universal quantifier, can now be easily represented by applying (in)finite conjunction to the set of people (cf. Jayaseelan (2001)). Ramchand (1997) is the first to capture this important insight between (1), (2), and (7) with the use of Rooth's (1984, 1996) semantics of contrastive-focus. As you can see, the semantic connection between (1), (2), and (7) is now very clear and this proposal becomes even more insightful because the meanings of "ka" and "mo" are disjunction and conjunction respectively in Japanese. This is the approach I am going to develop in this paper.

One problem with Ramchand (1997) arises if we try to represent the meaning of wh-questions in Japanese, though. As we have seen, it seems that the semantic difference between wh-phrases and existential quantifiers arises due to the position of "ka" in Japanese. However, there is no disjunction employed in the semantic representation of the wh-question, that is, in (34). Jayaseelan (2001), who discusses similar data in Malayalam, also notes this problem and argues that the meaning of wh-questions should be the following:

(38) a₁ came or a₂ came or a₃ came or ... , where a is human

However, (38) is not the meaning of (1) because it is only one proposition. The meaning of wh-questions is a set of possible propositions. In order to solve this problem, Jayaseelan claims that (38) turns into the meaning of the question pragmatically. However, as Higginbotham (p.c.) argues, this pragmatic account is not tenable. For instance, if the existential quantifier in (2) takes a wide scope, its meaning should be as in (38). But (2) is never used as a wh-question under any circumstances in modern Japanese. What is more, there seems to be a clear difference between propositions and questions, which is illustrated below:
The proposition that somebody came has been reported.

*The question that somebody came has been reported.

The question who came has been reported.

*The proposition who came has been reported.

It seems impossible to argue that the meaning of wh-questions and the meaning of sentences with existential quantifiers come from the same source. Therefore, the two meanings are quite distinct and should not be simply differentiated pragmatically. But if this argument is correct, where did disjunction go in the semantic representation of the wh-question? Later in the paper I will show that disjunction is employed also in the semantic representations of wh-questions in Japanese.

4 Hagstrom (1998)

Hagstrom also notes the similarity between (1) and (2) and tries to find the commonality between “ka” in (1) and “ka” in (2). He argues that “ka” denotes a choice function. In the literature the use of choice functions has been sought to account for the meaning of wh-questions in in-situ languages without assuming movements of wh-phrases (cf. Reinhart (1998)). The choice function is defined as follows:

(43) (from Hagstrom (1998: 130))

A function \( f \) is a choice function if it applies to a (non-empty) set and yields a member of that set.

Thus, the meaning of “dareka” is expressed as \( f(people) \) if we assume that “dare” denotes ‘people (x)’ and “ka” is a choice function. Hence, the meaning of (2) is represented as follows:

(44) \( \exists f \text{[came'}(f(people))] \)

In the case of the meaning of the wh-questions, (1), “ka” continues to have the choice function. But in addition to this, lambda abstraction over ‘w’ (‘w’ is a world) and an equation rule are added to the meaning, which Hagstrom attributes to the functions of a complementiser. The meaning of (1) is represented as follows:

(45) \( \lambda p \exists f \text{[p = } \lambda w \text{[came'}(f(people))(w)]} \)

(45) \( \lambda p \exists f \text{[p = } \lambda w \text{[came'}(f(people))(w)]} \)

There are a few problems with Hagstrom’s semantic representations. First, “ka” is regarded as a choice function in his approach. But as (3) shows, “ka” denotes disjunction. Comparing the complexity of meanings, “ka” as disjunction is more likely to be a primitive notion than “ka” as a choice function. What is more, Ramchand’s (1997) insight that indeterminates are contrastive-focused, and hence, provide a set of alternatives is not captured in Hagstrom’s analysis.

Secondly, a technical problem arises if we adopt a choice function to express the meaning of wh-questions. Consider the following example:
In (46), "jibun" ("self") is bound by the wh-phrase. Under Hagstrom’s analysis, (46) would be roughly represented as follows:

\[(47) \quad \lambda p \exists f [p = \^ f(\text{philosopher}) \text{ forgot } x \text{'s purse}]\]

(47) is problematic because ‘x’s’ (which corresponds to “jibun-no” in (46)) is not properly bound. This is due to the fact that the choice function, ‘f(philosopher)’, does not provide a variable, so that ‘x’s’ cannot inherit its reference through the variable. Thus, in this representation, ‘x’s’ cannot function as a bound pronoun. However, “jibun” can behave as a bound pronoun in (46). Therefore, the use of a choice function in wh-questions is not tenable unless this technical problem is resolved.

Finally, there are still differences between the two semantic representations, that is, (44) and (45). The introduction of lambda abstraction over ‘w’ (or of an intensional operator ‘\(^\wedge\)’) and ‘p=’ must be added to represent the meaning of (1). What we would like to achieve is to attribute the semantic difference between (1) and (2) to the syntactic difference, that is, the location of “ka”. In other words, if “ka” is attached to indeterminates, a meaning similar to an existential quantifier is generated. If the same “ka” is base-generated in C, it turns indeterminates into wh-phrases.

5 The present proposal
On the basis of the approaches introduced above, I would like to show how indeterminates can change into wh-phrases, existential quantifiers (-like items), and universal quantifiers (-like items) in Japanese. Before proceeding further, let me introduce a disjunction operator:

\[(48) \quad \text{Disjunction operator ‘}V\text{’}\]

\[P(x) \Rightarrow \bigvee x[P(x)] \quad \text{ where ‘P(x)’ is type } t.\]

\[\bigvee x[P(x)](a, b, c, \ldots) = P(a) \lor P(b) \lor P(c) \lor \ldots\]

The domain of the disjunction operator is a set of entities, ‘a, b, c, ...’, whose cardinality is more than one. This should be contrasted with a lambda operator:

\[(49) \quad \text{lambda operator ‘}\lambda\text{’}\]

\[P(x) \Rightarrow \lambda x[P(x)] \quad \text{(lambda abstraction)}\]

\[\lambda x[P(x)](a) = P(a)\]

With the use of the disjunction operator, it is possible to represent (35) as follows:

\[(50) \quad \bigvee x \text{ [came (x)]}(a_1, a_2, a_3, a_4, \ldots) \quad \text{ where } a \text{ is human}\]

This is equivalent to ‘a\(_1\) came or a\(_2\) came or a\(_3\) came or …’
Next let us turn to the meaning of wh-questions. Following Hamblin (1973), I assume that the meaning of a wh-question is a set of propositions. Thus, the meaning of (1) is represented as follows:

\[(51) \quad a_1 \text{ came, } a_2 \text{ came, } a_3 \text{ came, } \ldots \quad \text{where } a \text{ is human}^{15}\]

This representation seems to be a paradox because there is no disjunction represented. However, this representation is illusory and disjunction is, in fact, necessary to generate the set of propositions if an existential quantifier is not adopted. If (51) is represented using the disjunction operator, it looks as in (52):

\[(52) \quad \lambda p \vee x [p = x \text{ came}](a_1, a_2, a_3, a_4, \ldots) \quad \text{where } a \text{ is people}\]

(52) is equivalent to the following representation:

\[(53) \quad \lambda p [p = a_1 \text{ came or } p = a_2 \text{ came or } p = a_3 \text{ came or } \ldots ]\]

(53) provides the set of propositions such as (51) and this fact supports that disjunction is involved in the constructions of wh-questions in Japanese.

What I have done so far is to replace existential quantifiers in (9) and (10) with disjunction operators and remove the intensional operator in (9) with the use of contrastive-focus. However, the two representations, which are repeated below, still look different:

\[(50) \quad (\text{for (2) tentatively}) \quad \vee x [\text{came } (x)](a_1, a_2, a_3, a_4, \ldots) \quad \text{where } a \text{ is human}\]

\[(52) \quad (\text{for (1) tentatively}) \quad \lambda p \vee x [p = x \text{ came}](a_1, a_2, a_3, a_4, \ldots) \quad \text{where } a \text{ is people}\]

(52) additionally contains the variable, ‘p’, and ‘=’. Furthermore, lambda abstraction is applied in (52). It is one of the primary aims in this paper to minimise the differences between the two semantic representations even further, in other words, to explicate the interface between the syntax and the semantics of wh-questions in Japanese.

Following the framework of Bittner (1998) partially, I would like to define two rules.

\[(54) \quad (\text{from Bittner (1998), (i) is slightly modified.}) \quad \begin{array}{ccc}
\text{From} & \text{To} & \text{Definition} \\
(i) [=] & \tau & \tau & \lambda z_\tau[y_\tau = z_\tau] \\
(ii) [\exists] & <e, t> & <<e, t>, t> & \lambda P \lambda Q[\exists y(P(y) \land Q(y))] \\
\end{array}\]

The first rule is an equation rule and it changes the semantic type from ‘\(\tau\)’ to ‘\(t\)’, where ‘\(\tau\)’ can be any semantic type. For example, if ‘[=]’ is applied to ‘John’ (which is represented as ‘[=] John’), the rule changes the semantic type and produces ‘[y = John]’. The second rule introduces an existential quantifier and again raises the semantic type. For example, ‘[∃](boy)’ is
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers

equivalent to ‘\(\lambda Q[\exists y(\text{boy}(y) \land Q(y))]\)’. With these two type-lifting rules and the aforementioned disjunction and lambda operators, we are ready to tackle the problem.

First consider the following CP structure for (1), which is a wh-question:

\[(55)\]

\[
\begin{array}{c}
\text{NP} \\
\text{DP} \\
\triangle
\end{array}
\begin{array}{c}
dare \\
t_i \\
D \\
t_i \text{kimasita}
\end{array}
\begin{array}{c}
C' \\
\text{TP} \\
\text{C}
\end{array}
\]

I assume two things here. First, “dare” is base-generated in NP and overtly raised to the spec of DP because D has an EPP.\(^{17}\) Secondly, DPs containing wh-phrases are raised into the spec of CP covertly following Huang (1981/82). In (55) the wh-question particle, “ka”, is base-generated in C and the DP, “dare”, is raised to the spec of CP covertly. As before, I assume that “ka” denotes disjunction and that wh-phrases are contrastive-focused, and hence, they provide sets of alternatives. Thus, “dare” produces a set of people. In addition to these assumptions, I assume that “ka” has two more semantic functions: lambda abstraction, ‘\(\lambda\)’, and the equation rule, ‘[\(\equiv\)]’. As for ‘\(\exists\)’, following Bittner (1998), I assume that it as well as lambda abstraction can be freely applied when it is necessary to resolve type-mismatch.

The meaning of the wh-question, (1), is derived as follows:

\[(56)\]

\[
\begin{array}{c}
\text{NP}: \ y \\
\lambda y[y]
\end{array}
\begin{array}{c}
\rightarrow \\
\text{DP}: \ “dare” \ provides \ a \ set \ of \ people: \ a_1, \ a_2, \ a_3, \ a_4, \ldots, \ where \ a \ is \ a \ person \\
\lambda y[y](a_1, \ a_2, \ a_3, \ a_4, \ldots) \rightarrow a_1, \ a_2, \ a_3, \ a_4, \ldots
\end{array}
\begin{array}{c}
\text{TP}: \ \text{came’} \ (x) \\
\text{CP}: \ \text{The} \ \text{equation} \ \text{rule} \ \text{is} \ \text{applied} \ \text{to} \ \text{TP}: \\
\forall x \ [p = \text{came’} \ (x)] \rightarrow [p = \text{came’} \ (x)]
\end{array}
\begin{array}{c}
\text{The} \ \text{disjunction} \ \text{operator} \ \text{is} \ \text{applied} \ \text{to} \ \text{TP}: \\
\forall x \ [p = \text{came’} \ (x)] \ (a_1, \ a_2, \ a_3, \ a_4, \ldots)
\end{array}
\begin{array}{c}
\lambda p[\forall x \ [p = \text{came’} \ (x)] \ (a_1, \ a_2, \ a_3, \ a_4, \ldots)] \\
\text{Lambda} \ \text{abstraction} \ \text{is} \ \text{applied} \ \text{to} \ \text{TP}. \\
\lambda p((p = a_1 \ \text{came’}) \ \text{or} \ (p = a_2 \ \text{came’}) \ \text{or} \ (p = \ldots \ ])
\]
In DP, NP serves as a variable ('y') and “dare” serves as an operator. As a result, a set of people is provided. In TP, the trace of the wh-phrase is translated into 'x'. In CP, when the disjunction operator is initiated, it has two options: applying it to 'p' or 'x'. It is necessary to apply the operator to 'x' in order to derive an appropriate meaning. One way to guarantee this is to assume that disjunction variables are limited to type e. Then, the DP, which represents a set of people, a1, a2, a3, a4, ..., serves as the domain for the disjunction operator. Finally, the lambda-abstraction here, which I assume is one of the semantic functions of “ka”, is applied to bind the last open variable, 'p'. This is how the meaning of (1) is constructed.

Now let us consider how the meaning of (2), which is a sentence with an existential quantifier, is derived. But before proceeding, let me present the tree structure of (2) as follows:

As before, I assume that “dare” is raised to the spec of DP, so that its trace functions as a variable inside the DP. What is more, the entire DP is raised to the spec of TP to check its case and to leave its trace inside VP. Now consider the following semantic derivation:

D': The equation rule is applied:
\[ [=]_x(x) \rightarrow [p = x] \]
The disjunction operator is applied:
\[ \forall x [p = x] \]

DP: “dare” provides a set of people: a1, a2, a3, a4, ..., where \( a \) is a person
\[ \forall x [p = x] (a_1, a_2, a_3, a_4, ...) \]
Lambda abstraction is applied:
\[ \lambda p \forall x [p = x] (a_1, a_2, a_3, a_4, ...) \]

TP: \[ \lambda p \forall x [p = x] (a_1, a_2, a_3, a_4, ...), \text{came'} (y) \]
To resolve type-mismatch,
(i) ‘[\exists]’ is applied to the DP:
\[ \lambda Q[\exists z [\lambda p \forall x [p = x] (a_1, a_2, a_3, a_4, ...)](z) \land Q(z)] \]
\[ \rightarrow \lambda Q[\exists z [\forall x [z = x] (a_1, a_2, a_3, a_4, ...)] \land Q(z)] \]
(ii) lambda abstraction is applied to T':
\[ \lambda y [\text{came'} (y)] \]
Now combined (the lambda operator of the DP disappears here):

$$\exists z [\text{came'} (z) \land \forall x \ [z = x] \ (a_1, a_2, a_3, a_4, \ldots)]$$

(which is equivalent to:

$$\exists z [\text{came'} (z) \ & (z = a_1 \ or \ z = a_2 \ or \ \ldots)]$$

One important difference between (56) and (58) is that the equation rule is applied in CP in (56) and in DP in (58). This is a natural consequence because of the position of “ka”: “ka” is base-generated in C as in (55) and inside DP as in (57). This difference guarantees that (55) (or (1)) is a question whereas (57) (or (2)) is a proposition. Another difference is that ‘[∃]’ must be applied to the DP in (58) to resolve type mismatch, but this is semantically motivated. So this difference is not expected to appear in the syntax. Thus it is unnecessary to introduce a new syntactic feature to explain the difference. In this way it is possible to minimise the difference between the syntactic representations and the semantic representations of wh-questions in Japanese.

Let us compare the semantic representations of (1) and (2). Examine (59) and (60):

(59) Wh-question (for (1))

$$\lambda p \forall x \ [p = \text{came'} (x)] \ (a_1, a_2, a_3, a_4, \ldots)$$

The level where the equation rule is applied = CP

(60) Existential quantifier (for (2))

$$\exists z [\text{came'} (z) \land \forall x \ [z = x] \ (a_1, a_2, a_3, a_4, \ldots)]$$

The level where the equation rule is applied = DP

In (59) and (60), there seem to be only two differences. One is that the level where the equation rule is applied is over CP in (59) while it is over DP in (60). This is syntactically correspondent to the positions of “ka”: “ka” is in CP in (1) and it is in DP in (2). Thus, this difference is expected. The other difference is that a lambda operator is present in (59) while an existential quantifier is present in (60). As has been assumed, the source of the existential quantifier is to resolve type-mismatch, so it is semantically motivated. Thus, it is not surprising that syntax does not reflect the difference. As for lambda abstraction, it is also applied in the case of the existential quantifier though we cannot see it in (60). The lambda operator has disappeared in the middle of the derivation when combining with the other part of the tree diagram (cf. TP in (58)). Thus, the existence of the lambda operator does not constitute the real difference: lambda abstraction is applied both in (59) and in (60). In sum, we have shown that “ka” in wh-questions and “ka” in existential quantifiers have the same semantic functions. The only syntactic difference between “ka” in wh-questions and “ka” of existential quantifiers is the place where “ka” is base-generated. This naturally leads to the main semantic difference between “ka” in wh-questions and “ka” of existential quantifiers because of the level where the equation rule is applied. If this explanation is correct, we now can find clear correlation between the syntax and the semantics of wh-questions in Japanese.
Now let us consider the universal quantifier, which is made of an indeterminate and "mo". As we will see below, the same procedure as the existential quantifier does not produce a desirable meaning in this case. Consider (7) again, which is repeated below:

(7) Dare-mo-ga kimasita.

Ind-MO-NOM came

'Everybody came.'

Following the disjunction operator, I propose a conjunction operator below:

(61) Conjunction operator ‘\(\land\)’

\[
P(x) \Rightarrow \land x[P(x)]
\]

where ‘P(x)’ is type t.

\[
\land x[P(x)](a, b, c, \ldots) = P(a) \land P(b) \land P(c) \land \ldots
\]

I assume that the following tree diagram for (7):

As in "ka", I assume that "mo" has semantic functions such as the equation rule and lambda abstraction. In addition, "mo" has the conjunction operator as defined in (61). However, if we apply these semantic functions to (62) exactly in the same way as (58), we will end up having

\[
\exists z \left[ \text{came}\ (z) \land \land x\ [z = x] \ (a_1, a_2, a_3, a_4, \ldots) \right],
\]

where \(a\) is a person. This is equivalent to \(\exists z \left[ \text{came}\ (z) \land (z = a_1 \land z = a_2 \land z = a_3 \ldots) \right] \). However, there is a contradiction in this representation because ‘\(a_1\)' and ‘\(a_2\)', for example, denote different people and there is no ‘\(z\)' which satisfies ‘\(z = a_1 \land z = a_2\)’. To avoid this problem, we must assume that the conjunction rule applies after every other rule is applied. This is illustrated as follows:

(63) DP: The equation rule is applied:

\[
[=],(x) \Rightarrow [p = x]
\]

Lambda abstraction is applied:

\[
\lambda p[p = x]
\]
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers

TP: \( \lambda p \[ p = x \], \text{came'} (y) \)

To resolve type-mismatch,

(i) \('[\exists]') is applied to the DP:

\( \lambda Q[\exists z[z=x \land Q(z)] \)

(ii) lambda abstraction is applied to \(T'\):

\( \lambda y [\text{came'} (y)] \)

Now combined:

\( \exists z[\text{came'} (z) \land z=x] \)

The conjunction operator is applied:

\( \land x [\exists z[\text{came'} (z) \land z=x]] \)

"dare" provides a set of people: \(a_1, a_2, a_3, a_4, \ldots\), where \(a\) is a person

\( \land x [\exists z[\text{came'} (z) \land z=x]] (a_1, a_2, a_3, a_4, \ldots) \)

(which is equivalent to:

\( \exists z [\text{came'} (z) \land z = a_1] \land \exists z [\text{came'} (z) \land z = a_2] \land \ldots \)

As in (58), the equation rule is applied at the DP level because the rule is one of the semantic functions of "mo" and this "mo" is base-generated in DP. This fact guarantees that (62) turns into a proposition in the semantic module as in the existential quantifier case. However, unlike in (58), the conjunction operator is applied in the end. In this way, we can avoid the semantic contradiction mentioned above and we have '\(\land x [\exists z[\text{came'} (z) \land z=x]] \)' (\(a_1, a_2, a_3, a_4, \ldots\)), where \(a\) is a person', which is equivalent to '\(\exists z [\text{came'} (z) \land z = a_1] \land \exists z [\text{came'} (z) \land z = a_2] \land \ldots\)'. This represents the meaning of (7) accurately. Thus, though "mo" is base-generated at D, one of the semantic operations, that is, the conjunction operation, is applied at the TP level and this configuration produces a wide scope reading. In contrast, "ka", when base-generated at D, initiates the disjunction operation at the DP level as in (58) and this configuration creates a narrow scope reading. There are two possible solutions. One is to attribute this difference between "mo" and "ka" to a syntactic difference of "mo" and "ka". But as far as "dare-ka" ("someone") and "dare-mo" ("everyone") are concerned, there seems to be no syntactic difference: both "mo" and "ka" are base-generated at D. The other possible solution is to attribute the difference to a semantic reason. In other words, it is possible to argue that the conjunction operator cannot be initiated at DP because of a semantic reason. However, some may argue that semantic constraints do not affect syntactic aspects. Here I propose that a syntactic account should be employed to account for the constraint of "mo". But let me start with a semantic account first.

One can argue that the conjunction rule of "mo" must be delayed until every other rule is applied because, as we have seen above, a semantic contradiction may arise. However, natural languages normally allow semantic contradictions. For example, we can say "That man is John, and is also Steve" (even if "John" and "Steve" refer to different persons). Thus, such a semantic account may not be the correct reason for the restriction of "mo". Before presenting a syntactic account, let me discuss wh-constructions in Old Japanese.

One of the JJL referees asked whether the present analysis can be extended to explain
wh-constructions in Japanese, where “ka” may be base-generated next to wh-phrases, not in CP, (a similar phenomenon is also observed in Sinhala and Okinawan (cf. Hagstrom (1998)). It is indeed possible to explain such data only if I assume one thing. That is, if I assume that the two semantic functions of “ka”, the equation rule and the disjunction operator, are not initiated until wh-phrases with “ka” are raised to the spec of CP. Otherwise, wh-phrases with “ka” would represent existential quantifiers in Old Japanese, which is not the case. It is easy to explain why the equation rule is applied when a wh-phrase is raised to the spec of CP because it is possible that CP, not “ka”, has the equation rule in Old Japanese (unlike in present Japanese), which may have caused the verb to change its form. But it is not so easy to explain why the application of the disjunction operator is delayed because “ka”, which has the disjunction operator, is base-generated in DP. The reason may have to do with a special nature of wh-constructions in Old Japanese. Consider the following example from Shin Kokin Wakashuu (1205):

(64) (from Ogawa (1977: 222))
Tare-ka mata hanatatibana-ni omoi-idemu
who-KA again flower.orange-Dat remember
‘Who will again remember (me) at the time of the mandarin orange flower?’

One interesting observation is that in Old Japanese when particles such as “zo”, “namu”, “ka”, “ya”, and “koso” are attached to constituents, verbs must change forms. This phenomenon is called “kakarimusubi”. In the case of “ka”, verbs must be changed into adnominal (“rentai”) forms as in “omoi-idemu” in (64). Furthermore, according to Watanabe (2001), wh-phrases are obligatorily raised (that is, wh-phrases cannot stay in situ) in Old Japanese. This fact suggests that agreement between a wh-phrase with “ka” and some functional projection over a verb takes place in Old Japanese. This reasoning may further suggest that the disjunction operator of “ka” cannot be initiated until certain formal features of “ka” are checked off by such agreement-inducing overt movement. This may be the reason why wh-phrases with “ka” in conjunction with adnominal forms of verbs are never interpreted as existential quantifiers in Old Japanese unlike in modern Japanese, which lost the “kakarimusubi” agreement. 18

Let us come back to the restriction of “mo”. I have shown that the conjunction rule of “mo” must be applied after every other semantic rule is applied. I have not adopted the semantic account to explain this restriction because semantic contradictions do not cause ungrammaticality. Interestingly, this phenomenon is quite similar to the delayed application of disjunction in “ka” in Old Japanese. There, we have seen that the disjunction operator of “ka” must not be initiated until wh-phrases with “ka” are raised to the spec of CP, which I attributed to the claim that semantic functions cannot be initiated until certain syntactic features are checked off. We can employ a similar account for the restriction of “mo”. That is, the conjunction rule of “mo” cannot be initiated until certain syntactic features of “mo” are checked off. This implies that indeterminates with “mo” must go through some kind of feature-checking movement. In fact, NPs plus “mo” are known to induce “kakarimusubi” agreement in Old Japanese (cf. Hasegawa (1994)). Thus it is no wonder that such movement is still retained even for the case of indeterminates plus “mo” in present Japanese.

I have managed to show above that disjunction constitutes the core meanings of both existential quantifiers and wh-questions. Japanese is a suitable example of this illustration in that
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers 39

the meanings of existential quantifiers and wh-phrases are decided by the position of "ka". The difference in syntactic positions is reflected in the semantic differences. "Ka" has a disjunction operator. When "ka" appears at C, the level where the equation rule is applied is over CP, and when it is base-generated within the same constituent as wh-phrases, the level is over the wh-phrases, that is, over DP. On the basis of the positions of "ka" (apart from the lambda abstraction), the meanings of wh-questions and sentences with the existential quantifier are differentiated. In this manner we have managed to fill the gap between the syntax and semantics of wh-questions in Japanese. Though I have concentrated on Japanese wh-questions here, it is theoretically possible to extend this analysis to other languages. But I leave this for future research.

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Notes
1. Karttunen (1977) argues that wh-phrases are a kind of existential quantifiers. I will challenge this view later in this paper.
2. In many languages including Japanese and Mayalam, question particles are often omitted in wh-questions (see Jayaseelan (2001) for Mayalam). Furthermore, in the case of Okinawan and Sinhala, the occurrence of disjunction operators as question particles are quite limited (see Hagstrom (1998) for details).
3. I do not discuss NPIs (negative polarity items) in this paper.
4. For some reason, there is no universal-quantifier counterpart for "naze" ('why'), "*naze-mo". It may have something to do with the domain of quantification, i.e. the domain of "naze" tends to be propositional elements rather than referential elements. For example, another wh-phrase meaning 'why', that is, "doosite", allows both existential and universal quantifiers, "doosite-ka" ('for some reason') and "doosite-mo" ('at any cost'). As the English glosses show ('reason(x)' and 'cost(x)'), the domain of quantification is referential rather than propositional. Furthermore, the domain of "naze-ka" ('for some reason') is limited to referential elements. Thus, one could argue that "naze-mo" is not allowed because its domain is of propositional elements. However, this argument does not explain why the domain of "naze-mo" cannot be of referential elements unlike "doosite-mo". I leave this for future research and would like to thank one of the J JL referees for pointing this out to me.
5. In these representations and the rest of representations in this paper, tense is not appropriately represented. For the sake of exposition, I employ English tense morphology to express tense in semantic representations.
6. It should be noted that there is a slight difference between Hamblin (1973) and Karttunen (1977). The former assumes that the meaning of wh-questions is a set of possible propositions whereas the latter assumes that the meaning of wh-questions is a set of true propositions. I assume Hamblin (1973) in this paper.
7. See Higginbotham (1996) for a different view. He argues that the meaning of wh-questions is a set of sets of propositions. I do not discuss this possibility in this paper.
8. The same criticism applies to the traditional notations of existential quantifiers and wh-phrases as in (9) and (10).
9. From now on, I represent an indeterminate as “Ind” in the gloss.
10. Despite these facts, I continue to call an indeterminate plus “ka” an existential quantifier and an indeterminate plus “mo” a universal quantifier for the sake of exposition.
11. “Mo” also means ‘as well’ or ‘also’ as in the following example:

(i) John-mo kita.
   ‘John also came.’

“Mo” in this example is generated next to the focused phrase, “John”. If “John” is contrastive-focused and hence provides a set of people (whose members can be restricted by a context), the meaning of (i) is easily represented. Suppose the set of people is {John, Ken, Mary}. Then the meaning of (i) is represented as follows:

(ii) John came
    & Ken came
    & Mary came

(ii) can be understood as the meaning of (i) because (ii) implies that there is/are some who came in addition to John. The meaning arises due to the contrastive-focused phrase and the conjunction, “mo”. If this is a correct explanation, we have got another evidence for why indeterminates, which can be combined with “mo”, are contrastive-focused.
12. In Bengali, no wh-question particle is employed, so the problem above may not apply to Bengali cases.
13. I thank Jim Higginbotham (p.c.) for pointing this problem out to me.
14. I would like to thank Jim Higginbotham (p.c) for bringing this to my attention.
15. In fact, to represent propositions, I have to add the intensional operator to each proposition, for example, “\(\wedge \) came, \(\wedge \) came, …” But for the sake of simplicity, I omit this operator in this paper.
16. A case particle is omitted here and in later tree diagrams.
17. For the sake of exposition, I assume that traces are translated into variables in this paper. But this does not have to be the case. It is also possible to claim that a wh-phrases simply provides a variable and a restriction, and that there is an invisible operator which supplies a set of alternatives for the variable by anaphoric binding. In this case, no movement of wh-phrases, and hence, no EPP of D is necessary. I do not go into this problem further in this paper.
18. As for the diachronic change, I do not have much to say. It is quite possible that a reanalysis changed the status of “ka” into a complementiser in situations such as copular sentences where wh-phrases with “ka” may appear sentence-finally if copulas are omitted as follows:

(i) \([_{CP} \text{Sore-wa} \quad [_{DP} \text{dare ka} \quad (\text{desu})]]\)
   \(\text{That-Top} \quad \text{who KA} \quad (\text{copula})\)
   ‘Who is that?’
   \(\Rightarrow \ [_{CP} \text{Sore-wa dare} \quad [_{C} \text{ka}]]\)

As (i) shows, when we omit a copula, “ka” in “dareka” may be reanalysed as a complementiser, and hence, as a wh-question particle. I leave this for future research. See also Watanabe (2001).
The semantics of interrogative pronouns, existential(-like) quantifiers, and universal(-like) quantifiers 41

References


Hisashi Morita
The Department of British and American Studies
Aichi Prefectural University
Japan
hmorita@for.aichi-pu.ac.jp