ON INDIVIDUAL-LEVEL AND STAGE-LEVEL PREDICATES IN RESTRICTIVE IF-CLAUSES

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When-clauses cooccur most typically with stage-level predicates, since these predicates describe temporary properties. Atemporal when-clauses, which are discussed by Carlson 1979, are possible under certain restrictions on predicates and argument NPs. On the other hand, if-clauses are indifferent to kinds of predicate and have no restrictions on argument NPs. In addition, they can restrict epistemic modals, a property which when-clauses lack. Assuming the principle of quantification proposed by Kratzer 1989, I will argue that every difference between when and if is attributable to the fact that if-clauses can introduce the world variable $w$.

1. STAGE-LEVEL PREDICATES AND INDIVIDUAL-LEVEL PREDICATES. As discussed in Carlson 1977, there are two types of predicates, stage-level predicates and individual-level predicates. Stage-level predicates describe transitory properties whereas individual-level predicates describe permanent properties:

Stage-level predicate

(1) a. John is asleep.
   b. John is dancing.

Individual-level predicate

(2) a. John is intelligent.
   b. John has long arms.

Since the property of a stage-level predicate is transitory, the truth values of 1a and 1b may vary according to place and time. Suppose John is asleep is true now. The proposition may or may not have been true an hour ago. If John is dancing in the street is true, John is dancing in the room is false. The truth values of 2a and 2b are not expected to vary ac-

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cording to place and time. It is quite odd to say *John is intelligent now* or *John has long arms when he plays volleyball.* It is known that the stage/individual contrast realizes as a grammatical distinction in certain constructions:

*There* construction

(3)  
- a. There are dogs asleep.
- b. *There are dogs intelligent.

*Bare plural*

(4)  
- a. Firemen are available.
- b. Firemen are altruistic.

As in 3b, individual-level predicates cannot occur in the coda position of *there*-construction. In 4, the bare plurals are interpreted differently. Whereas 4a has an existential reading, 4b has a universal-like reading. Stage-level predicates and individual-level predicates also show different behavior in free-adjunct constructions (Stump 1985).

Kratzer 1989 proposes that stage-level predicates have an extra argument position for spatiotemporal location which individual-level predicates lack. The logical representations of (1-2)a are 5a and 5b, respectively:

(5)  
- a. [asleep (John, l)]
- b. [intelligent (John)]

When the place and/or time is specified for a stage-level predicate, such an expression is analyzed as a predicate of the extra argument:

(6)  
- [dancing (John, l) & in the street (l)]

2. **RESTRICTED QUANTIFICATION.** In the **UNRESTRICTED** quantification, quantifiers quantify over the whole domain of individuals. For example, 7a and 7b will be translated into logical representations in 8a and 8b, respectively:

(7)  
- a. Every child talks.
- b. Some tigers walk.
- c. Most fish swim.

(8)  
- a. \(\forall_x [\text{Child (x)} \Rightarrow \text{Talk (x)}] \)
  (Every individual \(x\) is such that if \(x\) is a child then \(x\) talks)
- b. \(\exists_x [\text{Tiger (x)} \& \text{Walk (x)}] \)
  (There is an individual \(x\) such that \(x\) is a tiger and \(x\) walks)
- c. \(\text{MOST}_x [\text{Fish (x)} \wedge \text{Swim (x)}] \)
  (Most individuals \(x\) are such that ???)

But no such representation will be given for 7c, because we cannot
choose an appropriate connective in 8c.

In the RESTRICTED quantification, the variable is restricted and it ranges over only the subpart of the domain. In 9a, for example, the intermediate clause restricts the value of the variable to the set of children. The quantifier quantifies over the set of children. Individuals other than children are irrelevant here:

\[
\begin{align*}
\text{(9) a. } & \forall x: \text{[Child (x)] [Talk (x)]} \\
\text{b. } & \exists x: \text{[Tiger (x)] [Walk (x)]} \\
\text{c. } & \text{MOST}_x: \text{[Fish (x)] [Swim (x)]}
\end{align*}
\]

Note that the restricted quantification provides natural language quantifiers with uniform representations without different connectives such as $\Rightarrow$ or $\&$. In particular, there is no difficulty in treating the quantifier most. I assume that the quantification in natural languages is the restricted quantification. And I will adopt the tripartite representation such as in 9, which includes a quantifier, the restrictive clause, and the nuclear scope.

3. WHEN AND IF AS RESTRICTIVE CLAUSES. I have assumed that the quantification in natural languages is the restricted quantification. Note that when/if-clauses function as restrictive clauses. Lewis 1975 argues that adverbs of quantification quantify over cases. In 10a, the quantifier always quantifies over the cases restricted by the when-clause. Specifically, the cases that are taken into consideration are only those where the proposition it rains is true. I assume that modal auxiliaries are also quantifiers over cases. Note also that the quantifiers of necessity, which are exemplified by always, must etc. may be implicit.¹

\[
\begin{align*}
\text{(10) a. } & \text{When it rains, it (always) pours.} \\
\text{b. } & \text{If the library has this book, it is (=must be) on the second floor.}
\end{align*}
\]

What are cases? It will be difficult to answer the question directly, since there are literally many cases, e.g. moments of time, stretches of time, events, states of affairs, etc. (Lewis 1975). The question should be answered more formally. That is, cases are defined by open sentences. More specifically, cases are defined by the variables included in open sentences. See the following paradigm:

\[
\begin{align*}
\text{(11) a. } & \text{*When Mary knows French, she (always) knows it well.}
\end{align*}
\]

¹ Another example of the necessity operator is generally. See section 6.
b. When Mary speaks French, she (always) speaks it well.
c. When a Moroccan knows French, she (always) knows it well.

(Kratzer, p. 6)

The logical representations of 11(a-c) are as in 12(a–c):

(12)  

a. *ALWAYS: [knows (Mary, French)] [knows-well (Mary, French)]
b. ALWAYS\(I\): [speaks (Mary, French, \(l\))] [speaks-well (Mary, French, \(l\))]
c. ALWAYS\(_X\): [Moroccan (\(x\)) & knows (\(x\), French)] [knows-well (\(x\), French)]

(Kratzer, p. 7)

When-clauses are typically temporal. Compare 12a and 12b. Stage-level predicates, which are assumed to have the spatiotemporal variable \(l\), allow when-clauses whereas individual-level predicates do not, because the latter have no inherent variables. But the occurrence of indefinite NPs may allow when-clauses, since indefinite NPs function as variables (Heim 1982). 11c is an instance of the atemporal when, to which I will return in section 6.

Kratzer proposes the condition on quantification in 13:

(13) Prohibition against vacuous quantification
For every quantifier Q, there must be a variable x such that Q binds an occurrence of x in both its restrictive clause and its nuclear scope.

(Kratzer, p. 9)

This condition correctly rules out 14b and 15b as well as 12a:

(14)  
a. *When Mary knows French, she (always) speaks it well.
b. *ALWAYS\(I\): [knows (Mary, French)] [speaks-well (Mary, French, \(l\))]

(15)  
a. *When Mary speaks French, she (always) knows it well.
b. *ALWAYS\(I\): [speaks (Mary, French, \(l\))] [knows-well (Mary, French)]

Kratzer's approach seems quite appealing and I think it is on the right track.

A cumbersome fact for this approach, however, is that if-clauses are indifferent to predicates. In particular, individual-level predicates occur in if-clauses even when they do not contain indefinite NPs:

(16)  
a. *When Mary knows French, she knows it well.
b. If Mary knows French, she knows it well.

(Kratzer, p. 10)
(17)  a. *When the library has this book, it must be on the second floor.
    b. If the library has this book, it must be on the second floor.

(Kratzer, p. 7)

There appear to be no variables in 16b and 17b, but they are acceptable. Kratzer notes that they are epistemic conditionals, and claims that epistemic modals are not quantifiers. If the implicit necessity modal in 16b and the epistemic must in 17b are not quantifiers, 16b and 17b will not make counter-examples to 13, since there is no quantification at all.

Kratzer claims that epistemic modals are never quantifiers but admits that deontic modals are quantifiers at least in some cases (See section 5).

First, this stipulation is ad hoc. Note that if-clauses can restrict deontic modals:

(18) If you are handicapped, you may be issued a special number plate. (=If you are a handicapped person, the law permits you to be issued a special number plate.)

Since the if-clause is made up of an individual-level predicate, there is no variable in it. So the deontic modal can not be quantificational in this case. Her stipulation is equivalent to claiming that deontic modals can be quantifiers only when there is a free variable. In her theory, modals do not have identity. They unreasonably change the status in order to save the principle on vacuous quantification in 13.

Second, if epistemic modals were not quantificational, there would be no reason to assume that the logical representations should have the tripartite structures, since there is nothing to be restricted. Why do if-clauses cooccur with epistemic modals? What is their function? Obviously, they do not restrict any quantifiers. A separate account will be needed for these ‘nonrestrictive’ if-clauses.

There seems to be good reason to assume that deontic and epistemic modals should be treated uniformly. I will assume that modals are quantifiers in general, and I will argue in sections 4 and 5 that nothing prevents this assumption.

4. THE WORLD ARGUMENT. Let us first note that when modals are introduced, we should take into account various possible worlds in addition to this actual world. Note further that the contrast between stage-level predicates and individual-level predicates seems to disappear when possible worlds are taken into consideration. In fact, the property of an
individual-level predicate is no longer 'permanent'.

Suppose the proposition John is intelligent is (invariably) true in the real world. We can think of many possible worlds in which John is not intelligent without any contradiction. Just as the truth value of John is asleep varies according to place and time, i.e. the value of \( l \), the truth value of John is intelligent varies according to different worlds. I propose there is another new argument \( w \) for the world specification. I assume \( w \) may be introduced when accompanied by if or a modal. We are now able to give the logical representations for 16b and 17b which observe Kratzer's principle of quantification:

\[
\begin{align*}
(19) & \quad \text{a. MUST}_w: \ [\text{know} \ (\text{Mary, French}), \ w] \ [\text{know-well} \ (\text{Mary, French}), \ w] \\
& \quad \text{b. MUST}_w: \ [\text{has} \ (\text{the library, this book}), \ w] \ [\text{be} \ (\text{this book, l}) & \ & \text{on-the-second-floor} \ (l), \ w]
\end{align*}
\]

The modal quantifier must binds two occurrences of \( w \), a well-formed logical representation. So there is no need to exclude epistemic modals from quantifiers. 19a will be interpreted as follows:

\[
(20) \quad \text{For every accessible world } w \text{ in which 'Mary know French' is true, 'Mary knows French well' is also true in } w.
\]

As for the interpretation in 20, I would like to omit discussion of accessibility. You may ignore the accessibility condition, since it is not

\[\footnote{I am using this word metaphorically. The concept of time will be held in possible worlds. Individual-level properties should be regarded as permanent within a single possible world. The distinction between stage-level and individual-level predicates will not be lost even if its effects are canceled.}

\[\footnote{Note that our logical representation of if is different from either of the following ones:}

\[
\begin{align*}
(\ i\ ) & \quad P \supset \text{MODAL} \ (Q) \\
(\ ii\ ) & \quad \text{MODAL} \ (P \supset Q)
\end{align*}
\]

In particular, we do not assume that if introduces the logical implication \( \supset \) but that it restricts the modal, which is a restricted quantifier. Schematically, our analysis may be better described as in (iii):

\[
(\ iii\ ) \quad \text{(MODAL}_x: \ [P(x)] & [Q(x)]
\]

Note also the fact that although standard modal logic does not regard (i) and (iii) as equivalent, their counterpart English sentences are equivalent (Karttunen 1972):

\[
(\ iv\ ) \quad \text{If Bill has a diamond ring, he must have stolen it from someone.}
\]

\[
(\ v\ ) \quad \text{It must be that if Bill has a diamond ring, he has stolen it from someone. Such a problem does not arise in our representation. In both cases, the if-clause describes the restrictive clause attached to the modal. Hence the synonymous interpretations are obtained. For a discussion of the syntactic variations of if-clauses, see Lewis 1975.}
\]
directly relevant to the purpose of this paper. I assume modals other than *must* are interpreted in the same way by replacing the quantifier *every* in 20.

As for stage-level predicates, the existence of *w* is apparently irrelevant, since they have the argument *l* inherently. There are cases where *w* plays a crucial role. Compare the *when*-clause in 21 with the *if*-clause in 22:

(21) *When John is asleep now, he always snores.*

(22) *If John is asleep now, he may sleep until tomorrow morning.*
The *when*-clause and the *if*-clause both contain *l*, but the value of *l* is contextually specified by the adverb *now*. The argument *l* is no longer a free variable. The logical representations will be 23 and 24:

(23) *ALWAYS*: [asleep (John, *l*) & now (*l*)] [snores (John, *l*)]

(24) *MAY*: [asleep (John, *l*) & now (*l*), *w*] [sleep (John, *l*) & until-tomorrow-morning (*l*), *w*]

Note that if *now* is not present, the sentence 23 is good, because *l* is free in the restrictive clause and can be bound from outside. In 24, the variable *l* is also not free in the restrictive clause. But *if* introduces another variable *w*, which *when* cannot introduce, and the modal quantifier properly binds it. The examples above make another piece of evidence for *w*.

5. **Epistemic Modals as Quantifiers.** Kratzer argues that epistemic modals are not quantifiers. Her argument is based on the example in 25:

(25) A car must be in the garage. (Kratzer, p. 10)
The indefinite NP in 25 can have a universal interpretation 26 or an existential interpretation 27:

(26) MUST*: [car (x)] [be (x, *l*) & in-the-garage (*l*)]

(27) MUST $\exists x$: [car (x) & be (x, *l*) & in-the-garage (*l*)]

“In all accessible worlds there is a car in the garage [italics mine, K.I.]” (Kratzer, p. 10)
The deontic reading is available in 26 which corresponds to the law to the effect that every car should be kept in the garage. The modal *must* is a quantifier and binds the indefinite NP. Another deontic reading is possible in 27. The reading may be equivalent to the rule: Do not leave the garage empty. An epistemic reading cannot be found in 26. It is only available in 27. But 27 is a problematic representation.4 If *must* is a

4 The logical form in 27 lacks the restrictive clause. But this is not the problem. Some restriction will be given by the accessibility condition and the context.
quantifier in 27, the representation will be ruled out since there is no variable to bind. Kratzer stipulates that deontic modals are optionally quantificational and epistemic modals can never be quantificational.

If we assume the world variable \( w \), 27 will be like 28:

\[
(28) \quad \text{MUST}_w \exists_x [\text{car} (x) \& \text{be} (x, l) \& \text{in-the-garage} (l), w]
\]

The epistemic modal \textit{must} is a quantifier and quantifies over possible worlds. Note that the interpretation quoted under 27 indicates universal quantification over worlds, a fact suggesting the existence of the variable \( w \).

If epistemic and deontic modals are both quantifiers, what is the difference between the two? The difference will be stated as the conditions on variable selection:

\[
(29) \quad \text{Conditions on variable selection}
\]

\begin{enumerate}
\item Deontic modals are unselective binders.
\item Epistemic modals are selective in that they can bind only the world variable.
\end{enumerate}

Although I cannot fully discuss the reason why epistemic modals cannot bind variables other than \( w \), the distinction in 29 is intuitively understandable. Laws and rules may choose everything as their objects. You can make rules for every individual object: \textit{A person must do such and such; a car must be such and such}, etc. And of course, rules may be concerned with a pair of individuals, time and place, or even the world. On the other hand, the object of cognition is limited to the world. Cognition may be focused on some particular object, but we take it as part of the world.

We are now able to give account for the fact that \textit{when}-clauses cannot restrict epistemic modals:

\[
(30) \quad \text{When-clause cannot restrict an epistemic modal because it lacks the world argument} \ w.
\]

Let us examine the following examples in detail:

\[
(31) \quad \begin{align*}
\text{a. When someone uses that car, it must be fixed.} \\
\text{b. If someone uses that car, it must be fixed.}
\end{align*}
\]

Suppose an old broken car is left in the garage. 31a will be used in such a situation, and has a deontic reading:

\[\text{The problem seems to remain that although sentence 25 is ambiguous in three ways, it has just two logical forms. But the ambiguity between deontic and epistemic readings in 27 is solved by the accessibility condition. I will not pursue this issue here.}\]
(32) MUST;: [uses (someone, that car, l)] [be-fixed (that car, l)]
Since the deontic must is an unselective binder, it binds the l. The same reading is available in 31b.6 An epistemic reading is possible in 31b but not in 31a:
(33) MUSTw: [uses (someone, that car, l) & nowadays (l), w] [be-fixed (that car, l) & now (l), w]
In this situation, the speaker supposes that there is someone who (habitually) uses the car nowadays, which may or may not be true in the real world. And the speaker concludes that in every case (=world) where the supposition is true, the car is already fixed. Notice that the variable l is assigned a specific value by the context. It is because the epistemic must selects w and cannot simultaneously bind l. The logical form in 33 also has a deontic interpretation. This interpretation is slightly different from that of 32. In 32, the obligation is the action to fix the car. In 33, the obligation is the state that the car is fixed. The difference comes from the properties of the bound variables. Specifically, the spatiotemporal variable l is associated with events whereas the world variable w defines how the world is constituted.

6. ATEMPORAL WHEN. This section does not intend a full discussion of the atemporal when. Instead, I will argue that certain crucial features of the atemporal when are predictable from the principle of quantification.
Carlson 1979 argues that the atemporal when, a typical example of which is 34, has the characteristics in 35:
(34) Bears are intelligent when they have blue eyes.
(35) a. The main clauses must be interpreted generically.

6 As we are assuming that if and modals can introduce w, you may suspect that the representation in 32 should contain w. The restrictive clause of 31b and the main clauses of both 31a and 31b may introduce w. But even if w is introduced, it cannot function as an independent variable. It cannot be bound by the modal. It must be assigned a specific value and the value is probably this actual world, just as the argument l is assigned the value now. You might even consider that when-clauses have the variable w in the logical representations, if the value is obligatorily assigned. In such a theory, existence and absence of variables are irrelevant. What is crucial is whether variables can function as true variables. I do not like complicated representations including irrelevant variables, so I stipulate that if and modals have just the potential to introduce w. They actually introduce the variable only when it is necessary.
b. There must be an NP in the main clause of the appropriate sort—that is, an NP on the kind level.  
c. There must be a pronoun in the *when*-clause anaphorically related to the appropriate NP in the main clause.  
d. The appropriate NP in the main clause must not have predicated of it a kind-level predicate.7  

(Carlson 1979: 74)

The characterization in 35 appears to be incorrect as it is. But when corrected, all these characteristics fall under Kratzer’s condition on quantification in 13.

First, 35a is not the case. Generic interpretation is not a necessary condition for the atemporal *when*:

\[(36)\] Some children are insufferably conceited when they have rich parents.  

(Declerck 1988)

In fact, 35a will be reduced to two conditions:

\[(37)\]  
a. There is a quantifier in the main clause.  
b. The implicit quantifier is the generic operator.8

Atemporal *when* is nothing but a kind of restrictive *when*.

Second, a kind-level NP is not necessary, either. We find in Farkas & Sugioka 1983 an example of the atemporal *when* with an indefinite NP like 38:

\[(38)\] A bear is intelligent when it has blue eyes.

An indefinite singular is not a kind-level NP, because it cannot cooccur with a kind-level predicate:

\[(39)\]  
a. *A bear is widespread.

b. Bears are widespread.

So condition 35b is not a true characterization. Note also that condition 35d is irrelevant for indefinite NPs. But condition 35c must be relevant in both cases, since it is the principle 13 itself. The sentences in 36 and 38 have the following logical representations:

\[(40)\]  
a. \(\exists x: \text{[child (x) & have (x, rich parents)] [insufferably-conceited (x)]}\)

b. {GEREALLY\(\forall x: \text{[bear (x) & have blue eyes (x)] [intelligent (x)]}\)}

How about 34? It would have the representation in 40b if the bare plural

\[7\] According to Carlson 1977, individual-level predicates include kind-level and object-level predicates.

\[8\] I will assume that the generic operator is one of the necessity quantifiers.
subject were a variable. Carlson claims, however, that bare plurals are names of kinds. They are not variables in themselves. How can we make variables from the constants. Here the condition 35d is relevant. When an object-level predicate is predicated of a bare plural NP, an object-level variable is introduced, since object-level predicates describe properties of objects, not those of kinds. The interpretation of 41 will be 42a, which is roughly paraphrased as in 42b:9

\[(41)\] Bears are intelligent.

\[(42)\]

a. \((\lambda y^k) \) (GENERALLY\( x^o \): [REALIZE \( (x^o, y^k) \) [intelligent \( (x^o) \)]) (bearsk)

b. The kind bears has the property such that every realization of it is intelligent.

For convenience, I will use the representation after \(\lambda\)-conversion:

\[(43)\] GENERALLY\( x^o \): [R \( (x^o, bear^k) \) [intelligent \( (x^o) \)]

We are now able to give a well-formed logical representation for the typical atemporal when in 34:

\[(44)\] GENERALLY\( x^o \): [R \( (x^o, bear^k) \) & have blue eyes \( (x^o) \) [intelligent \( (x^o) \)]

When a kind-level predicate is predicated of a bare plural NP, the realization function R does not work, and no variable is introduced. Condition 35d correctly excludes 45:

\[(45)\] *Wolves are extinct when they are stupid.

Incidentally, Carlson 1979 and Farkas & Sugioka 1983 seem to suppose that there is a realization relation between object and stage. Apparently, this is true of examples like 46:

\[(46)\]

a. John is grouchy when he is hungry.

b. ALWAYS\( x^s \): [R \( (x^s, John^o) \) & hungry \( (x^s) \) [grouchy \( (x^s) \)]

But no such representation will be given for 47, since the restrictive clause does not contain the pronoun coreferential with John:

\[(47)\] John is grouchy when it rains.

Since this is a case of temporal when, the variable is \( l \) rather than the stage-level realization of John:

\[(48)\]

a. ALWAYS\( l \) [hungry (John, \( l \)] [grouchy (John, \( l \)]

b. ALWAYS\( l \) [rains (it, \( l \)] [grouchy (John, \( l \)]

---

9 It is inaccurate to paraphrase the quantifier generally with the universal quantifier every, since the former allows exceptions. For example, if you find a single stupid bear, 42b will be falsified, but the generalization in 41 still holds.
The prohibition against vacuous quantification does not require a pair of coreferential NPs, which is indispensable in the atemporal when:

(49) *Dogs are intelligent when cats have blue eyes.

I would like to conclude that realization is the relation between kind and object.\(^{10}\)

As we have discussed, kind-level predicates generally do not occur with the atemporal when. There is no such restriction for if-clauses. Obviously, it is because they can introduce the world argument \(w\). Compare 50 with 45:

(50) Wolves would be extinct if they were stupid.

The existence of \(w\) in each clause is sufficient to satisfy the condition on quantification. The situation is similar to the cases of temporal when. And coreferential NPs are not needed:

(51) Wolves would be extinct if people were stupid.

Again, the contrast between atemporal when and if confirms the adequacy of our analysis of if-clauses.

7. CONCLUSION. Stage-level predicates freely cooccur with when-clauses because they inherently contain the spatiotemporal variable \(l\). If the predicates of the restrictive clause and the main clause are both stage-level, Kratzer's condition on quantification is automatically satisfied. For individual-level predicates to meet this condition, variables must be provided by argument NPs, since individual-level predicates do not have the inherent variable. So there are narrow restrictions on the level of predicates, the kind of argument NPs,\(^{11}\) and coreferrality.

I claimed that if-clauses may introduce the world argument \(w\). That is why if-clauses cooccur with any predicates as freely as when-clauses cooccur with stage-level predicates. Assuming the presence of \(w\), we made a unified account of deontic and epistemic modals. In addition, we explained the reason why when-clauses cannot restrict an epistemic

\(^{10}\) Realization may be between kind and subkind, since kind-level predicates may sometimes occur in the atemporal when:

(i) Canaries are popular when they are rare. \(\text{(Farkas & Sugioka 1983)}\)
This type of realization is not always possible. Although judgments are sometimes unclear, it seems impossible with extinct but possible with widespread:

(ii) *Wolves are extinct when they are stupid.

(iii) Wolves are widespread when they are intelligent.

\(^{11}\) The examples cited in this paper are those of indefinite NPs and bare plurals with the exception of 36. For further discussion on this matter, see Declerck 1988.
modal.

I did not explicitly mention the fact that if-clauses can make counterfactual conditionals as distinct from when-clauses. This fact seems to suggest the presence of $w$, since counterfactual conditionals are descriptions of worlds other than this actual world. Certainly, more evidence will be necessary for $w$, but I think it a viable assumption that all the peculiarities of if originate from $w$.

REFERENCES