IF AND *WHEN* CLAUSES: ACCOUNTING FOR THEIR SEMANTIC SIMILARITIES AND DIFFERENCES

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Abstract: This paper addresses the question of the interpretation of *if* clauses in comparison with *when* clauses. Both seem interchangeable in the context of a generic operator. Modal operators, on the contrary, seem to be more selective and are ungrammatical with a *when* clause. The generalization provided before was that modal operators are incompatible with *when* clauses. In this paper, I show that the alleged incompatibility is not universal and that an explanation of the difference centered around the restrictive role of both *if* and *when* clauses is explanatory more successful.

Keywords: *if* clause, *when* clause, material implication, quantification, tripartite structure, operator, restriction, nuclear scope.

0. INTRODUCTION

In recent years the study of the interpretation of quantifiers has received great attention and as a consequence, a very sound theory of quantification has been developed. Moreover, linguists have been able to reveal parallelisms between determiner quantifiers and adverbial quantifiers. For instance, assuming a tripartite structure with a quantifier, a restriction and a nuclear scope for both, it has been proposed (von Fintel 1994), that the *if* clause provides the restriction, like a noun with a determiner quantifier.

In this paper, following these approaches to quantification in general and, to *if* clause in particular, I address several issues. First, I notice that the semantic role of the *when* clause is not totally parallel to the role of the *if* clause; in fact, in the interaction of both *if* and *when* clauses with adverbial quantifiers and modal operators, it is shown that *when* clauses are ungrammatical in contexts where *if* clauses are perfectly fine. This contrast was attributed to a difference in coping with a constraint proposed here: the Vacuous Restriction constraint.

1. THE THEORY OF QUANTIFICATION AND IF CLAUSES

Equating the interpretation of natural language *if* clauses with first-order logic material implication has always been a very appealing proposal. Since early times the shortcomings

this approach were pointed out (Cooper 1979, Gazdar 1979, Sanford 1989, Seuren 1985, and Stalnaker 1968), weakening the alleged equivalence.[1] Nevertheless, the identification of natural language conditionals with material implication received new interest with the introduction of Gricean[2] conversational implicatures. In effect, Grice proposed that natural language conditionals are like material implication once the conversational implicatures at play in each case are abstracted away. In other words, differences between natural language conditionals and material implication can be explained by invoking conversational implicatures.

Kratzer (1991) gives a historical review of the identification of material implication with conditionals and points out how 'the recent history of semantics can be seen as a history of the gradual decline of the material conditional' [Kratzer 1991:652]. In fact, she notes, there was a time when sentences containing quantifiers like *all*, illustrated in (1), were interpreted with material implication. The semantic interpretation is shown in (2):

(1)   All porches have screens
(2)   For all x [if x is a porch, then it has screens]

The limitations of the possibilities of this type of formalization became apparent when looking into other quantifiers like *some*, *most*, *many*, *few*, etc. In the case of the interpretation of the first quantifier, *some*, a different two-place connective had to be used, namely, the conjunction. Von Fintel (1994:3) notices two problems with this type of formalization:

(i) there is no constituent corresponding to the NP-constituent of English and one would wish more parallelism between the syntax and the semantics.

(ii) the nexus is not constant in the representation of all the quantifiers. Material implication appears in the formalization of *every*, while conjunction used when formalizing the quantifier *some*.

These two objections plus the impossibility of accounting for less straightforward quantifiers, such as *many*, *most few*, led to a theory of restrictive quantification. The main proposal in this theory is that quantifiers are second-order relations between sets[3]. In this sense, a quantifier like *most* receives the following representation:

(3)   [Most x: x is a porch] x has screens

In (3) the clause *x is a porch* has the function of restricting the domain of the quantifier *most*. This is a very important notion, by restricting the domain of a quantifier we mean that it does *not quantify over anything*, but over a limited set of entities, namely, the ones expressed by the restriction. In Kratzer's words, (3) is true 'in a world w, if and only if most values for x that satisfy *x is a porch* in w also satisfy *x has screens* in w' [Kratzer 1991:652]. Thus, quantifiers are viewed as functions from sets to sets; a function from the set of values that satisfy *x is a porch* onto the set of values that satisfy *x has screens*.

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[1] For a review of the arguments against the identification of natural language conditionals and material implication, and how he dismisses them, see P.J.G.M. Nieuwint (1992), chapter 5.

[2] See H. P. Grice 'Logic and Conversation' printed in *Pragmatics*, pp. 305-315.

[3] According to Heim and Kratzer (to appear, chapter 7) this is the so-called 'relational' theory of quantification, which goes back to Aristotle, Euler and Frege. If *first-order relations relate individuals*, second-order relations relate sets of individuals or characteristic functions. To give an example from this manual, *every* denotes the subset relation. Thus, *every goat is a mutt* is understood as stating that the set of goats is a subset of the set of mutts.

1.1. Lewis' contribution: quantification over cases

What impact does the theory of restrictive quantification have on any semantic account of *if* clauses? Before tackling this issue, we need to apply the theory of quantification to contexts other than a quantifier within a nominal phrase. This is the core of Lewis' proposal which captures the parallelism between determiner quantifiers and adverbial quantifiers. Thus, in his 1975 article, Lewis proposed that adverbs like *sometimes*, *always*, *most of the time*, etc. quantify over cases[4]. The target of quantification, the "case", is defined as follows:

> 'Our adverbs are quantifiers over cases: a case may be regarded as the 'tuple of its participants; and these participants are values of the variables that occur free in the open sentence modified by the adverb. In other words, we are taking the cases to be the admissible assignments of values variables'
>
> [Lewis 1975:7]

Von Fintel (1994) points out that there are advantages in considering these adverbs as quantifiers, given that this treatment can account for two observed facts:

(i) the quantificational variability effect: it was first noticed by Lewis (1975) that there seems to be a relation between the indefinite and the adverbial of quantification (4a). The interpretation of the indefinite plus the adverb in these examples is semantically equivalent to the corresponding one with a determiner quantifier, as in (4b):

(4)   a.   A blue-eyed bear is $\left\{ \begin{array}{l} \text{always} \\ \text{usually} \\ \text{often} \\ \text{sometimes} \\ \text{seldom} \\ \text{never} \end{array} \right\}$ intelligent

b. $\left\{ \begin{array}{l} \text{All} \\ \text{Most} \\ \text{Many} \\ \text{Some} \\ \text{Few} \\ \text{No} \end{array} \right\}$ blue-eyed bears are intelligent.

Examples in (a) can be paraphrased with examples in (b). The Lewis-Kamp-Heim approach proposes that in (4a) the adverbial quantifier quantifies over a variable which is supplied by the indefinite. In this sense, the indefinite is not assumed to be an existential quantifier, but a restricted free variable.

(ii) The second observation related to adverbial quantifiers is the famous 'donkey-anaphora'. Consider the following example:

(5)   Often, if a farmer owns a donkey, he beats it.

The problem is how the indefinites in the *if* clause can bind the pronouns in the main clause, which appear to behave as bound variable pronouns. Heim (1982) proposed that the variables bound by the adverb are supplied by the indefinites in the *if* clause. They are *unselectively bound* by the adverb of quantification. In the example above:

(6)   Often $_{x, y}$ [a farmer (x) & donkey (y) & x owns y] [x beats y]

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[4] In Kratzer (1991) the quantification is over events, and in von Fintel (1994) over situations. I will obviate the differences among these concepts.

"many pairs x, y such that x is a farmer, y is a donkey, and x owns y,
are such that x beats y".

1.2. Kratzer's thesis: if-clauses as restrictions on the domain of an operator
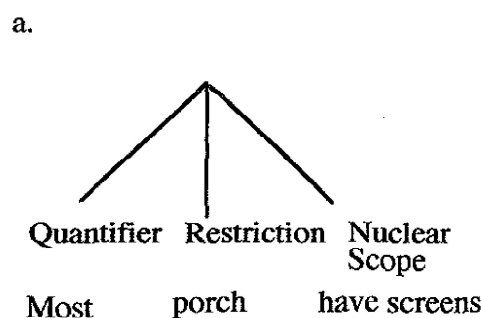
Let us go back to our initial question, the relation between material implication and conditional clauses. If both are equivalent, the logical representation of conditional clauses in (7) will be as in (8):

(7)   a. Sometimes, if a man buys a horse, he pays cash for it
        b. Most of the time, if a man buys a horse, he pays cash for it

(8)   a. There is an event e [if e an event that involves a man buying a house, then e
        is part of an event in which this man pays cash for it]

        b. For most events e [if...(e)..., then ... (e) ...]

Kratzer, however, shows the inadequacy of such an interpretation with the following argumentation. Let us imagine a world where there are a million events. Out of these, 2000 events involve a man buying a horse, and all of the 2000 events involve payment by check. There are, however, 998000 events where there is no action of buying a horse, therefore, in all those situations the antecedent is false and the consequent is false too. This makes the combination of the *if* clause and its consequent true, since material implication holds between the two. Consequently, in this world, against our intuition, (7a) and (7b) are true.
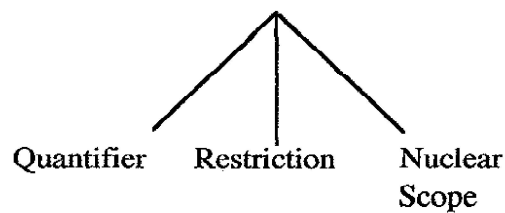
It becomes clear, and this an assumption in von Fintel's work as well, that the conjunction *if* is not a mere link between the antecedent and the consequent, as implied with the material implication analysis. Instead, the relation is a more complex operation where the *if* clause plays a crucial role. More specifically, the *if* clause performs the operation of restricting the domain of the quantifier, the adverbial quantifier. That is why in Kratzer's example, the domain where the consequent is evaluated does not involve a million events, but only the events where a man buys a horse.

At this point the analogy of adverbial-quantifiers with determiner-quantifiers reveals itself. This parallelism, whose origins trace back to Heim's (1982) work, can be observed in Fig. I:

a.

Quantifier Restriction Nuclear
                        Scope

Most   porch   have screens

b.

Quantifier   Restriction   Nuclear
Scope

sometimes [if a man buys a horse] [he pays cash for it]

Fig. I: Analogy between Determiner quantifiers and Adverbial quantifiers.

It is clear that the *if* clause performs the same function as the noun in a quantificational structure, namely, it restricts the domain of the quantifier.

2. OPERATORS

Traditionally, the adverbial quantifier is treated as an operator, that is, an element that performs a given 'operation'. In this paper, we will distinguish two kinds of operators: the generic operator and the modal operator.

2.1 The Generic Operator

In habitual sentences, exemplified in (9a) or in universal statements such as the one in (9b), there is what has been called a generic operator:

(9)   a. John smokes a cigar after dinner
        b. A potato contains vitamin C, amino acids, protein and thiamine

Thus, examples of these characteristics are often analyzed (Farkas and Sugioka 1983, Diesing 1988, Wilkinson 1990, etc.) as including a phonologically null adverb of quantification, roughly equivalent to 'habitually' or 'generally'. The same type of operator is present in *if* and *when* clauses so that a habitual reading is implied:

(10)   John eats fish if/when he goes to San Sebastián
(11)   Op -> Gen
        Restriction --> John goes to San Sebastián
        Nuclear Scope --> John eats fish

The interpretation is that most situations in which John goes to San Sebastián are part of a bigger situation where he eats fish, following von Fintel's (1994) approach. Although Rooth (1985) noticed that examples with *when* are ambiguous in the sense that the proposition in the *when* clause can be part of the Nuclear Scope, I do not attempt to explain this difference and I will conclude that both *if* and *when* are equally acceptable with a generic operator.

2.2. The Modal Operator

Kratzer (1995) noticed that English *if* clauses can restrict epistemic modals while *when* clauses cannot. This contrast is illustrated in (12):

(12)   * (When) / if the library has this book, it must be on the second floor

From this difference in grammaticality she concludes that although a *when* clause can restrict the domains of various operators, it cannot restrict the domain of an epistemic modal. The same contrast can be found in other languages, such as Spanish and Basque:

(13) a. *(Cuando) /si la biblioteca tiene ese libro, tiene que estar en el segundo piso
      b. Liburutegiak liburu hori badauka/*daukanean, bigarren solairuan izan behar du
         'When/if the book has that book, it must be on the second floor'

      c. *(Cuando)/si Juan es inteligente, terminará ese acertijo a tiempo
      d. Jon azkarra *denean/bada, igarkizun hori garaiz bukatuko du
         'When/if Juan is smart, he will finish that puzzle on time'

Schematically this can be represented as in Fig. II:

Modal op   si/*cuando   Main clause

Fig. II: The difference in grammaticality between the *if* and the *when* clause with a Modal Operator.

Apparently, it seems then that neither in Spanish nor in Basque, *when* clauses can restrict the domain of an epistemic operator. *If* clauses, on the other hand, are suitable for this task. This, however, is not a completely true generalization given that there are examples of *when* clauses restricting epistemic modals which are grammatical in Spanish and Basque:

(14) a. Cuando/si Juan viene a casa tan temprano, debe de tener poco trabajo en la
         oficina
      b. Jon hain goiz etxera etortzen denean, oso lan gutxi eduki behar du bulegoan
         'When/if Juan comes home this early, he must have little work at the office'

      c. (para) Cuando/si María habla francés, lo debe de saber muy bien   (English*)
      d. Mirenek frantsesez hitzegiten duenean, oso ondo jakin behar du
         'When Mary speaks French, she must know it well'

It seems clear that these examples convey an epistemic reading like examples in (13). The difference between examples in (13) and (14) is that in the latter, the predicates in the subordinate clause are stage-level predicates. This fact allows for their interpretation. That this epistemic reading is available can be shown by including the linking phrase, *es que*, 'that is':

(15) a. (para) Cuando/si Juan se queja, es que debe de tener mucho dolor
         'by when/if Juan complains, it is that he must be in real pain'
      b. (para) Cuando/si María habla en francés, es que lo debe saber muy bien
         'by when/if María speaks French, it is that she must know it very well'

Thus, it is safe to conclude that unlike in English, Spanish *cuando* and Basque *-ean* 'when' can restrict epistemic modals. In light of this cross-linguist difference, one can ask whether the ungrammaticality of (12) and (13) with *when* is not due to some other reason. As I pointed out before, our grammatical examples in (14) exhibit a stage-level predicate unlike examples in (12) and (13). It can be proposed that *when* clauses, like regular *if* clauses, do not accept an individual-level predicate in epistemic readings in the subordinate clause. This generalization can be represented as in Fig. III:

Modal Op   cuando   Nuclear Scope
              -ean
           stage-level
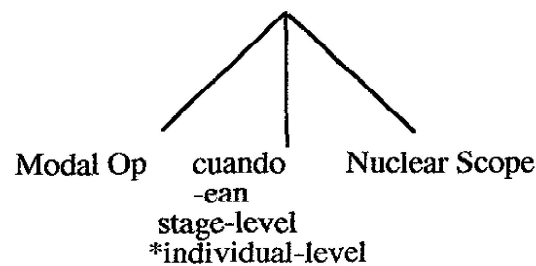   *individual-level

Fig. III: Ungrammaticality of individual-level predicates in the *when*-clause

Therefore, the relevant difference is not only the *if* versus the *when* clause, but also whether the predicate is stage or individual-level. The impact of the type of predicate on the grammaticality of *when* clauses was already noticed by Kratzer (1995). I summarize her proposal regarding this distinction in the next section.

3. PROHIBITION AGAINST VACUOUS QUANTIFICATION

Kratzer (1995), following Chomsky (1982), argues that in natural languages there is a prohibition against Vacuous Quantification, which she formulates as follows:

(18)   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

Assuming that indefinites are interpreted as variables, it is easy to see how this prohibition predicts the grammaticality of examples like (19a) and (19c), where *a Moroccan* and *a foreign language* provide a variable and, the quantification structure is therefore non-vacuous:

(19)   a. *When Mary knows French, she knows it well
        b. When a Moroccan knows French, she knows it well
        c. When Mary knows a foreign language, she knows it well

Notice that the same predicate 'to know', an individual-level predicate, appears as ungrammatical when there is no variable. Thus, example (19a) is ungrammatical because there is no variable for the quantifier to bind.

According to this proposal an example like the one we offered in (10), repeated here, should present some variable, otherwise our Prohibition in (18) would rule it out:

(20)   John eats fish if/when he goes to San Sebastián

In effect, Kratzer (1995) proposes on the basis of semantic and syntactic evidence that stage-level predicates involve an extra argument that individual-level predicates lack: a spatio-temporal argument. The *when* clause has to bind a variable and that is what differentiates the grammaticality of stage-level predicates from the ungrammaticality of individual-level predicates in this type of clause. Since the individual-level predicate has no intrinsic variable to bind, there is going to be a violation of the Prohibition against Vacuous Quantification in examples such as the one in (19a). Notice the contrast between a stage-level predicate and an individual-level predicate:

(21)   a. When Mary speaks French, she speaks it well
        b. *When Mary knows French, she knows it well

Summarizing, it was shown that the initial generalization that *when* clauses cannot be in the restriction of a Modal operator is not correct. In fact, I gave some examples from Spanish and Basque where the *when* clause performs such a restriction. Looking for a different explanation, it was noticed that the dichotomy individual/stage-level predicates is responsible for the ungrammaticality of the *when* clause. At this point, I summarized Kratzer's (1995) findings on the two types of predicates. She proposes a constraint that disallows Vacuous Quantification in natural languages. Therefore, individual-level predicates are ungrammatical because they lack a variable and constitute instances of vacuous quantification. This constraint, however, seems to be too strong. In the following section, I give examples that violate this Prohibition against Vacuous Quantification and I propose an alternative constraint.

4. PROHIBITION AGAINST VACUOUS RESTRICTION

The preceding section summarized a requirement for quantification, namely, that in order for a quantificational structure to be grammatical there has to be a variable x both in the restriction and in the nuclear scope. It is possible to find examples that defeat this generalization. Let us consider the following examples from Spanish and Basque:

(22)   a. Su hermana se sorprende muchísimo cuando/si a Juan le gusta una película
        b. Bere arreba izugarri harritzen da, Joni pelikula bat gustatzen zaionean/bazaio
           'Her sister is very surprised when/if John likes a movie'
        c. Los oficiales de aduana se alegran mucho cuando/si un extranjero sabe inglés
        d. Aduanako ofizialak izugarri pozten dira atzerritar batek ingelesa badaki/dakienean
           'Customs officers get very happy, if/when a foreigner knows English'

In Kratzer's system, the semantic representation of these examples will be as in (23), where l(ocation) stands for the spatio-temporal argument that stage-level predicates, unlike individual-level predicates, have:

(23)   a. Always x, l [film (x) & like (john, x)] [surprise (his sister, l)]
        b. Always x, l [foreigner (x) & know (x, English)] [rejoy (officials, l)]

These examples violate Prohibition in (18), given that there is no variable bound by the adverbial quantifier both in the restriction and the nuclear scope. Consequently, examples in (22) should be ungrammatical, contrary to our intuition. At this point, I conclude that the Prohibition against Vacuous Quantification is too strong. Nevertheless, the idea that there has to be some constraint along those lines that rules out examples like the ones in (12), (13) and (19a) seems correct. Thus, given the possibility of examples that do not share the same variable in the *if/when* clause and in the main clause, I propose a less strong Prohibition that looks solely at the restriction: the Prohibition against Vacuous Restriction. I formulate this restriction in (24) below:

(24)   Prohibition against Vacuous Restriction
        The restriction has to perform the operation of selecting some (and not all)
        situations as true out of the word under consideration.

Thus, an example with an individual-level predicate in the *if* clause is going to be ungrammatical in the context of quantification. Let us illustrate how this Prohibition rules out examples like the one in (25) with an individual-level predicate in the if clause. The main clause also has an individual-level predicate but that is irrelevant with respect to (24):

(25)   *Si Juan tiene los ojos azules, es inteligente
        'If Juan has blue eyes, he is intelligent'

Its representation, according to von Fintel's situation semantics would be a formulation like the on in (26):

(26) $\{$ s: usually * $\langle$ min ([g(6)∩[[Jon has blue eyes]]), π(min([[he is intelligent]])$\rangle$ $\}$

This proposition will be true in a situation s iff most minimal situations in g(6)[5] in which Jon has blue eyes are part of a minimal situation in which he is intelligent. The problem with this interpretation is that the restriction does not restrict, given that in all our minimal situations, the proposition *Jon has blue eyes* is true. Therefore, this is the reason why (25) is ill-formed. It is clear how this constraint explains the ungrammaticality of individual-level predicates in the *if/when* clause without a variable. By definition, any individual-level predicate is true in all situations in our world of evaluation and, this makes it a vacuous restriction.

Notice, however, that not all individual-level predicates in the restriction are ungrammatical. In fact, with generic NP's the examples are acceptable. Let us consider a classic example[6]:

(27) Los perros son inteligentes si/cuando tienen ojos azules
      'Dogs are intelligent if/when they have blue eyes'

The implied adverbial 'usually' ranges over 'dogs with blue eyes'. In other words, there is a selection of situations that include dogs with blue eyes and discard brown-eyed dogs or blue-eyed cats. The paraphrases of example in (27) will be as follows:

(28) 'the proposition will be true in a situation s iff most of the situations where a dog
      has blue eyes in the world of s are a part of a situation where the dog is
      intelligent'.

Notice that the constraint in (24) does not have any effect when quantification involves a situation with a generic NP represented with a variable. Given this variable, there cannot be a vacuous restriction. In fact, every time a situation is selected where there is a dog, for instance, it is discarding all the situations where no dog is available.

Spanish and Basque *when* clauses can restrict the domain of an epistemic modal, as long as there is a stage-level predicate or a variable. *If* clauses, on the other hand, are not as selective with respect to the predicate-type. The reason for this asymmetry between *if* and *when* can be found in the nature of the conditional conjunction. In fact, it has been noticed that the *if* clause can look not only in the world under consideration but in other worlds. The most clear example is a counterfactual conditional. Let us imagine a situation where we do not know if Juan is blond or not, simply since we have not seen him. However, we need a person with dark hair so that he plays a given character, for instance. Given that context, an utterance like the one in (29) would be felicitous:

(29) Si Juan es rubio, lo teñimos de moreno
      'If Juan is blond, we dye his hair brown'

In (29) the interpretation is not that Juan is blond in all the situations in our world, but rather let us look for a world where that is true. Thus, it allows to comply with the Restriction on the Vacuous Constraint. The same example is ungrammatical with *cuando* even with the verb in the Subjunctive mood:

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[5] g(6) is called the 'resource domain' or a contextually supplied set of situations. It takes its value deictically from the context or anaphorically from other linguistic material.

[6] Carlson (1977, 1979) was the first who noticed the peculiarity of these examples.

(30)   *Cuando Juan es/sea rubio, lo teñimos de moreno
        'When Juan is/is.SUBJ blond, we dye his hair brown'

Cuando or *-ean* may be able to restrict a modal, but unlike *si/ba*-'if', it cannot look into other worlds besides the present one. Moreover, it needs a stage-level predicate, exactly as it was shown with adverbial quantifiers.

When clauses that restrict epistemic modal operators are subject to the restriction in (24) too. *If* clauses in quantificational contexts are also dependent upon this requirement, but given that they restrict a modal operator, they can move to other words and the requirement becomes almost always satisfied. Summarizing, if clauses with an individual-level predicate and no variables is fine given their possibility to minimally select a given possible world. When clauses, on the other hand are out under the same circumstances. The reason for their ungrammaticality is that they are performing a vacuous restriction, given the fact that they are linked to the world of evaluation.

Another question that arises with respect to this point is why examples with individual-level predicates in the if clause sometimes are interpretable and sometimes they are not. For instance, example (25), repeated here as (32), cannot involve a modal operator, and an example like the one in (31) can:

(31)   Si Juan tiene el pelo oscuro, es de España
        'If Juan has dark hair, he is from Spain'

(32)   *Si Juan tiene los ojos azules, es inteligente
        'If Juan has blue eyes, he is intelligent'

I propose that the answer has to do with our knowledge of the world, and how certain propositions can be more naturally linked to some other propositions. It is certain knowledge of the world, the one that makes us accept some epistemic readings and makes us discard others. Thus, it is easier to find a possible world where dark-hair is connected to being a Spaniard than a world where there is some connection between being blue-eyed and being intelligent. It is in principle possible to create an artificial context where speakers' knowledge includes a correlation between the color of the eyes and intelligence. Within that common ground, the utterance in (32) would not be starred.

5. CONCLUSIONS

Previous research has postulated that the *if* clause, in analogy with the noun in a quantification structure, restricts the domain of a given operator. We explored both generic and modal operators not only in combination with *if* clauses but also with *when* clauses, which apparently have the same role.

Kratzer's (1995) accounts for the impossibility of individual-level predicates in the *when* clauses without a variable by postulating a Prohibition against Vacuous Quantification. This Prohibition was deemed too strong given that some Spanish and Basque examples were incorrectly ruled out by it.

An alternative to the Prohibition against Vacuous Quantification was proposed. Instead of looking into both the restriction and the nuclear scope, I proposed to check the restriction only. Thus, I proposed the Prohibition against Vacuous Restriction in (24), whose roots can be found in the natural economy in language. This Prohibition makes it impossible for *when* clauses to cooccur with an individual-level predicate, unless there is a variable, namely a generic NP or indefinite. The *if* clause, on the other hand, has the escape-hatch of moving to other 'possible worlds'. This strategy makes it almost impossible for the *if* clause to be non-restricting, since it minimally selects a world to be considered. *When* clauses, on the other hand, are linked to the world under evaluation.

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