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REGULATIONS ON USE**Stephen C. Levinson and Asifa Majid**

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10. 'Logical' Connectives in Natural Language: a first questionnaire

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Goal and motivation

To find out what variation we have in our language sample, with a view to a possible future project. A reason for pursuing this topic: human reasoning might be quite influenced by the formal means available in the language, despite a non-linguistic substrate: Western logic is transparently related to European sentential connectives (cf. Staal on Indian logics), which lexicalize and make salient certain truth-functions (most of which cannot be unambiguously expressed at all in say Guugu Yimithirr). Even if the propositional calculus is innately provided to us, the particular connectives grammaticalized/lexicalized in a language may constrain the form of normal syllogistic reasoning (there are e.g. exactly 16 possible different two-place truth-functional connectives, but at most only 2 or 3 of these show up in English - see Gazdar 1979:69).

We may take the classical connectives (more properly truth-functional expressions, thus including negation) as the focal category to explore. In actual fact the questionnaire below uses English "and", "if", etc., although these are well known not to map directly onto their logical counterparts (the conditional is particularly suspect). Some provision is made for this problem in the example sentences but it should be borne in mind by the researcher.

Background

1. Logic and implicature

It's quite plausible that the particular logical connectives used in classical logic are a precipitation from European languages. They are defined purely in terms of how the truth (T) or falsity (F) of the propositions (clauses) - the parts of the whole expression - determine the truth of the whole. So for negation "Not-p" is T iff p is F; for conjunction "p & q" is T iff both p and q are T, "p v q" ('p or q') is T iff at least one of the two propositions p or q is T, "if p then q" is F only if p is T and q is F.

There are some important formal (truth-functional) equivalences to bear in mind, e.g. (i) order is irrelevant for conjunction and disjunction: "p or q" = "q or p" (ii) conditionals can be paraphrased in many ways, e.g. "if p then q" = "not p or q" "if p then q" = "if not q then not p" (iii) scope of (e.g.) negation over connectives is important "not (p or q)" = "not-p and not-q" (iv) "p if and only if q" = "if p, q and if q, p"

It's well known that these truth-functional definitions don't capture by any means all of the meaning and/or uses of the corresponding English connectives, but at least quite a bit more of the meaning can be captured by standard pragmatic inferences. So "p or q" implicates not both, "if p then q" implicates (or perhaps conventionally entails) that there is some connection (e.g. causal) between p and q, and that the speaker is uncertain of p, etc.

2. Other languages

1. Negation

It's well known that many languages have a range of negations for different purposes, and it is often hard to find a clausal negator of a kind similar to "not" or "~". It's worth trying to figure out how many there are, and what the maximum scope of each is.

2. Conjunction

Similarly many languages lack a clear clausal conjunction, relying instead on parataxis or specialized coordinators (temporal, causal, etc.) or subordinators (purposive, etc.). Again, it is worth cataloguing the different means for coordinating NPs e.g. "John and Bill", VPs "come and go", and clauses.

3. Disjunction

Again distinguish "NP or NP" from "VP or VP" from "S or S". Note again that many languages avoid the issue, using dubitatives or epistemic modifiers ("perhaps p, perhaps q").

4. Conditionals

This is the most complex area to investigate; many languages employ quite different formal means to distinguish counterfactuals ("if you only were here, I would be happy") from plain conditionals. Some languages simply lack a dedicated conditional, and many languages have no formal counterfactual conditionals. Again, conditional notions may be invoked through marking epistemic uncertainty ("perhaps he comes, I go"), or even just parataxis ("you do that - I'll hit you"). There are often complex interactions with illocutionary force and mood (e.g. promises and threats - "you pay me and I'll leave you alone").

QUESTIONNAIRE

PART 1: Collecting translation equivalents

As a first step, bearing in mind the above issues, try collecting the translation equivalents of the following English sentences (or culturally appropriate alternates - you'll need to be both culturally and linguistically inventive). In each case you should try to test for other - perhaps simpler, more general - ways of saying the same thing, which may well vary with the illocutionary force (watch out for offers, requests, warnings, etc.) and epistemic modification (evidentials, subjunctive etc.).

Priority should be given to 2 and 3 (conjunction and disjunction) and first part of 4 (ordinary conditionals), then 1 (negation), then the rest. Even fairly superficial information would be welcome at this stage.

Even work with one consultant should be sufficient to provide useful information.

Where the English sentences contain material in brackets, this is meant to gloss the English, rather than be translated directly.

1. NEGATION

This is likely to be a complex topic; just try to get an overview of the negative morphemes and their interaction with prosody, placement word-order or other indications of scope. The main point is that we can later look at how negation interacts with conjunction etc.

1.1. John didn't hit Bill, Mary did

1.2 John didn't hit Mary, he kissed her

1.3 John didn't hit Bill, he hit Mary

1.4 The book is not red

1.5 There are no unicorns/unicorns don't exist (for unicorn try "black yams" etc.)

1.6 I have no money

1.7 That is not a tree, it's a bush (OR 'that's not an egg, it's a stone')

1.8 That's not (just) hot, it's really hot (boiling, etc.)

2. CONJUNCTION

Things to watch out for here: different kinds of NP (pronouns, persons, things) and different numbers of NPs may conjoin differently - e.g. one might use dual-3rd person pronoun, or comitative. Subject and object position may also make a difference. Similarly for VPs: some may gap and the reciprocal may have broad uses. In general check for restrictions on interpretation - does the reverse order of conjuncts mean the same thing? - does John and Bill came absolutely require that both came?

2.1 John and Bill came

try also e.g.: John and Bill and Harry and the horse came

I saw a big rock and a little man

2.2. John came and (then he) went

2.3 John hit Bill, and (then) Bill hit Mary

2.4 John hit Bill and Bill hit John back (reciprocal - check interpretation)

2.5 John bought a goat, and Bill sold a cow and Sam killed a chicken

2.6 John didn't hit Bill, and Bill didn't hit John

John hit Bill and Bill hit John back

3. DISJUNCTION

We may expect less forms for disjoining compared to conjoining: but check this against whatever features made a difference for conjunction-forms (e.g. NPs: pronouns, persons, object- vs. subject-position, NP vs. VP, S-disjunction). Carefully check the interpretations (truth-conditions) for the sentences: e.g. for 3.1 "John or Bill went to town" is it T if just John went, just Bill went, both went or even none did? Be especially careful about whether one just has a dubitative (in which case the "or none" interpretation should go through).

3.1 John or Bill went to town

3.2 John lost or broke the spade

3.3 John took the spade or Bill took the rake

3.4 Either the neighbours stole my pigs or someone else did

3.5 The neighbours stole my pigs, or someone else did (or both).

3.6 Neither John nor Bill went to town

3.7 (We've quarreled so) Neither will John come here or I go there

3.8 It's possible that either John came or Bill came (or both, or none)

3.9 One of them has to do it: either John must go, or Bill must.

4.0 CONDITIONALS

A conditional form may be identified by having something like the truth-conditions of the material conditional ("if p q" F only if p is T, q is F) plus a causal interpretation (or so Comrie suggests). If there is such a form, still check under what conditions a conditional may be paraphrased by conjunction ("You do that and I'll beat you") or disjunction ("Don't you do that or I'll beat you") or simple parataxis ("Do that, I'll beat you").

For historical/theoretical rather than typological reasons it is good to check not only straight conditionals, but also counterfactuals - are these expressed using the same form (plus uncertainty/counterfactual marking)? Typologically one may expect the conditional form itself to carry some varying degree of uncertainty.

4.1 NON-COUNTERFACTUAL CONDITIONALS

Be alive to possible tense/modality restrictions; check epistemic uncertainty implications (e.g. can one say "Cholera is (certainly) lethal. If Cholera is lethal, the government should set up rural clinics"). Expect some complex interactions with illocutionary force (offers, threats, requests, permissions) and modality. Check whether the if-clause or the then-clause is truly subordinated (e.g. Arrernte has main/subordinate options in the then-clause, Tamil has subordinate if-clauses); check also whether there is any single-clause use of the construction (cf. "If only the weather was better").

4.1.1 If John comes, Mary will leave

(check this is false if John comes and Mary stays, otherwise true; check also embedding in indirect discourse: Bill said if John comes, Mary will leave)

4.1.2 If John doesn't come, Mary will leave

4.1.3 If he takes this medicine, he will recover

4.1.4 If he doesn't take this medicine, he won't recover

4.1.4.1 Unless he takes this medicine, he won't recover

4.1.5 If you pay me, I'll teach you English (otherwise not)

4.1.6 If you don't help me, I won't pay you

4.1.7 Even if you help me, I won't pay you

4.1.8 If you have 2 dollars, and I have one, then we together have three.

4.1.9 If John was born before Alice, and Alice before Mary, then John was born before Mary

4.1.10 If these are John's footprints, then he was here.

4.1.11 If you want to eat, there is food in the house.

4.1.12 If and only if you come, will John go (iff you come will John go)

4.1.13 If you are an Englishman, I am a monkey's uncle! (i.e. if p and q are obviously false, is the conditional true?)

4.2 COUNTERFACTUALS

Some languages have a different construction(s) here, others will simply add subjunctive/evidential/contra-to-fact marking to the conditional. Check, if there is a proper construction, whether the counterfactual marks actually only an 'improbable', 'low certainty' event (Comrie's prediction).

4.2.1 If John had come, Mary would have been happy (but he didn't)

4.2.2 If John had not come, Mary would have been happy (but he did)

4.2.3 If he had taken this medicine, he would have recovered (but he didn't)

4.2.4 If he had not taken this medicine, he would not have recovered

4.2.5 If you had payed me, I would have taught you English

4.2.6 If you had not helped me, I would not have paid you

4.2.7 Even if you had helped me, I would not have pay you

4.2.8 If you had \$2, and I had \$1, then we would have had \$3 between us (but alas we don't)

4.2.9 If John had been born before Alice, and Alice before Mary, then John would have been born before Mary (but in fact he was born last)

4.1.10 If these had been John's footprints, then he would have been here.

4.1.12 If you had wanted to eat, there would have been plenty food in the house.

5.0 COMPOUNDS OF CONNECTIVES (some already above)

This section just checks the free combination of conjunction/disjunction within conditionals, etc.; if this is impossible, how are these things communicated?

5.1 If John had come and Bill had left, Mary would have been happy

5.2 If John had come, or Bill had left, Mary would have been happy

5.3 It's not true that if John had come, Mary would have been happy

5.4 If it is true that if we weep it rains, then it is going to rain (since we have been weeping)

5.5 If John came Mary will be happy, or if he didn't then she'll be sad

6.0 CRUCIAL PERAPHRASTIC EQUIVALENCES

This is a way to check how close the language's connectives are to the logical ones; one can expect some fairly general failures of equivalence for pragmatic reasons, in addition to any semantic difference. Some of the laws of logical equivalence are as follows:

6.1 "p or q" = "q or p"

John came or Bill went = Bill went or John came

6.2 "p and q" = "q and p"

John bought a cow and Bill sold a pig = Bill sold a pig and John bought a cow (one expects a pragmatic difference where events that can be interpreted as causally related, e.g. John came and borrowed a spade = John borrowed a spade and came)

6.3 "not (p or q)" = "not-p and not-q"

It's not true that Mary or Bill lost the money = Mary didn't lose it and Bill didn't lose it

6.4 "not (p and q)" = "not-p or not-q"

It's not the case that (both) Harry left home and Bill ran away = Harry didn't leave home or Bill didn't run away

6.5 "if p then q" = "not-p or q"

If you worked hard, you are tired = You haven't worked hard or you are tired
If I am right, you owe me a dollar = Either I'm wrong or you owe me a dollar

6.6 "not not-p" = "p"

It's not the case that you are not right = you are right

6.7 "p or p" = p

You are wrong or you are wrong = you are wrong

6.8 “p or q” = “not(not-p and not-q)”

You are wrong or I am wrong = It’s not the case that you are right and I am right

6.9 “if p then q” = “if not q, then not p”

If Harry came, Mary left = If Mary didn’t leave, Harry didn’t come

Other things

1. True and False

Are there simple lexical equivalents for True and False?

How are these terms used? What other senses do these terms have?

Can one say: ‘What that man said is True.’; ‘What that man said is False.’; ‘What that man said is True and False’.

2. Propositions

You should think about the status of the notion proposition with respect to the language you are working on. To do this you may want to consider (i) whether the language distinguishes direct and indirect quotation (for both speech and thought), (ii) whether the language has factive complements for speech and knowledge predicates (e.g. I know that she has money) and (iii) the range of evidentials the language has and how they are used.

3. Other possible truth-functions

Note that English “without” isn’t normally construed as a truth-function for syntactic reasons (it’s a subordinator without main verb in second clause), although “p without q” is basically equivalent to “p and not q”. Thus one needs to be open-minded to a range of possible truth-functions in other languages: “p without q” is T iff p = T and q = F (otherwise F). Gazdar (1979:75ff) predicts no truth-functions in natural language will depend purely on the order of conjuncts, nor will there be any that take two false propositions into a true one.

4. Quantification

Make sure you know how to express quantification, e.g “all the boys are rascals” vs. “some of the boys are rascals” (or “there are some rascally boys”).

PART 2: Collecting reasoned arguments

Try finding out how a reasoned account or argument is naturally constructed. From a logical point of view, we are in the first instance interested in the verbal form of deductive argument from premises to information already implicitly contained in them (rather than inductive or abductive argument, or ‘best guess’ reasoning). Naturally, it is hard to exclude extra assumptions, probabilistic reasoning, moral reasoning etc., in any natural argument, but one should try to constrain the example, or at least to clarify which part contains such ‘extra-logical’ elements.

Some scenario, like trying to figure out how some thief managed to get away with the theft, may serve to elicit such an argument: “Someone stole my watch. The door was locked. So he must have come either through the window, or by removing a section of the wall/roof. But if he came through the wall/roof, he carefully replaced it. If he went through the window, we should be able to find the footprints outside. If he went through the wall/roof, there should be bits of thatch on the floor. If we can’t find any traces, then someone else must have a key to the door. etc.”

But how exactly should we elicit such arguments for comparative purposes? Here are some ideas: (I suggest you try more than one of these ideas)

6.1 Provide a thief-scenario:

e.g. the window is open, the door is locked, there are no footprints outside the window, only one person has the key, the wall planks can be moved, the money box is broken, a screwdriver was left near the scene, only two people in the village use a screwdriver, etc. The money from the box is missing - who stole it and how? And how do you know? [see above for an 'example' of a reasoned argument to this scenario].

6.2 Ask about kin-reckoning:

If this woman is my brother's wife's sister's daughter, what is she to me? Why? Can I also describe her as my aunt's daughter? How many other kinds of aunt's daughter are there? And what am I to her? Why?

6.3 Ask about ontological categories:

Is this a bug? Why? Are bugs alive? How do you know? If ants are alive, are ant-hills alive? Why not?

6.4 Ask about rules of games (card games, basketball, whatever)

Is this a legitimate move? Why not? What would be? Why? Does this count the same as that? Why does this count as winning? etc.

6.5 Ask about some simple transitive relations:

A is bigger than B; B is bigger than C; so which is bigger, A or C? Why? A was born before B, B before C; so who is the youngest? Why? (you could also try our spatial transitivity task, but don't pollute your subject pool!)

6.6 Wason card-task (version from Science Museum, 1977:120)

There are four cards thus:

1. circle to left, hidden area to right O H
2. blank to left, hidden area to right _ H
3. hidden area to left, circle to right H O
4. hidden area to left, blank to right H _

Task: ascertain truth of:

"If there is a circle to the left, then there is circle to the right" by removing the obstruction from as few of the hidden areas as possible.

Correct solution: remove H in 1, and H in 4 (not in 3, since the conditional - unless read as a biconditional - does not rule out other situations in which there is a circle to the right) - following the principle that for the material conditional ("if p then q") the only falsifier is "p and not-q"

6.7 In some of the film stimuli there are sequences that might form a basis for questioning: e.g. Pear Film: why does the pear-picking man seem puzzled at the end as the boys walk past? Where did they get the pears? Why did the boy give the other boys pears? etc.

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