

### 3.2. Formal Translation Revisited: Conditional Clues and Complications

**1. Antecedent and Consequent.** We'll find the conditional pickier and trickier than earlier molecular sentences, calling for distinctions between its parts that other sentences did without.

Recall that we took a casual attitude toward the order of parts in a conjunctions or disjunctions, thanks to the '**commutativity**' of the wedge and the vel: as far as truth and validity go, the **order of parts makes no difference**. So whenever it's true that "We're having truffles and we're having grog," it's true that "We're having grog and we're having truffles" (and vice versa); and likewise whenever it's true that "Either we're having pho or we're having sushi," it's true that "Either we're having sushi or we're having pho" (and vice versa). That left us indifferent to which was the left part of a conjunction or disjunction, and which was the right part – a point reflected in our generic labels "left part" and "right part".

But **order of the parts does make a difference** to a conditional, since swapping those parts can transform a true conditional into a false one (or a false into a true one). Even if it's **true** that

If the Bobcats lost, then Rex is upset

it may well be **false** that

If Rex is upset, then the Bobcats lost.

Perhaps lots of things upset Rex, and here it's someone keying his car, or the raccoons getting into the garbage. In general: **switching the order of parts in a true conditional is *not* guaranteed to yield another true conditional**.

For that reason we distinguish between (what we might call) the '*if*' part of the conditional and its '*then*' part. And since these names won't always prove appropriate, we coin two new bits of logical jargon: the (so-called) '*if*' part is the **antecedent** of the conditional, while its '*then*' part is the **consequent**.

In our earlier example, “The Bobcats lost” was the antecedent, while “Rex is upset” was the consequent.

If the Bobcats lost, then Rex is upset.



But while antecedent and consequent in this English sentence are each marked by a special word (“if” and “then,” respectively), the formal language instead marks them by their location: in a formal conditional the **antecedent** always **comes before the arrow**, the **consequent** always **after the arrow**. In the following formal conditional, for instance, the location of the parts is sufficient to mark “P” as antecedent and “Q” as consequent.

**P:** The Bobcats lost    **Q:** Rex is upset

If the Bobcats lost, then Rex is upset

**(P → Q)**

And as with English conditionals, so with formal ones: in a certain situation “(P → Q)” may be true while “(Q → P)” is false.

That has immediate consequences for English-to-formal translation: unless we’re painstaking about determining which part of an English conditional is the antecedent and which is the consequent, and take care to place their translations in the proper spots (either before or after the arrow), we may translate a true English conditional into a false formal one.

Yet while that illustrates how conditionals are picky – about which part is which – it doesn’t make them look especially tricky. After all, the antecedent of an “if... then” sentence is marked with “if,” and the consequent by “then”; so keeping them straight looks simple.

Anyway there’s a second clue here: the order of parts in an “if... then” sentence perfectly parallels the formal language: both sentences place the antecedent first and consequent last. With these two clues in hand, translating English conditionals into formal ones looks trouble-free.

But two complications of English, familiar from the previous chapter, return to spell doom for both those clues; for in light of those complications we’ll see that neither of the above clues offers a reliable marker of antecedent or consequent. Appreciating that point, we’ll appreciate as well how translating conditionals can indeed be tricky.

**2. First Complication: Translation Variations.** In Chapter Two we found that every model example of logical form in English – “and,” “or,” and “not” – came with a variety of cousins meaning the same thing, and translated into the formal language the same way: the **translation variations** on those model cases.

English conditionals are no exception. All the following phrases count as **conditional phrases** of English, translated by an arrow.<sup>1</sup>

**Conditional Phrases:**

<b>If P then Q</b>	<b>Provided (that) P, Q</b>
<b>If P, Q</b>	<b>Assuming (that) P, Q</b>

**Exceptional Conditional Phrase:**

**P only if Q**

(Why we separate “only if” from the other phrases is explained below.)

So the following conditionals are translated into the same formal sentence.

**P:** It’s raining    **Q:** It’s cloudy

**If** it’s raining, **then** it’s cloudy  
**If** it’s raining, it’s cloudy  
**Provided that** it’s raining, it’s cloudy  
**Assuming that** it’s raining, it’s cloudy  
  
 It’s raining **only if** it’s cloudy

} **(P → Q)**

<sup>1</sup>Adapting the translation variations in Suppes 1957: 8, Quine 1959: 41, and Kalish and Montague 1964: 11.

As the first two examples illustrate, “if” can appear with or without its partner “then” – revealing “then” as a purely optional part (like optional “both” with “and,” and optional “either” with “or”).

We see now why we traded in the phrases “‘if’ part” and “‘then’ part”: not all English conditionals contain the words “if” and “then”. But every conditional has an antecedent and a consequent.

We see as well why our first proposed clue for finding antecedent and consequent isn’t reliable: since not every English conditional contains “if” and “then,” we can’t count on the antecedent to be flagged by “if,” nor the consequent by “then”.

**3. Second Complication: Inversion.** A further complication comes from inverted English sentences. **Inversion** is familiar from conjunctions and disjunctions: the ‘standard’ disjunction “We’ll have a picnic unless it rains” can be inverted to become “Unless it rains, we’ll have a picnic.” With disjunctions and conjunctions inversion could be taken in stride, since the order of the parts made no difference to truth or validity. But we can’t be so casual about order of parts in a conditional; for as noted, “ $(P \rightarrow Q)$ ” may be true while “ $(Q \rightarrow P)$ ” is false.

That makes inversion a particularly unwelcome complication when translating conditionals. For now the second proposed clue in distinguishing antecedent and consequent – that antecedent comes first in English, consequent after – also proves unreliable. Note that both the standard and inverted conditionals here have the same antecedent (“it’s raining”) and consequent (“it’s cloudy”).

#### **Standard Conditional (Antecedent First)**

Antecedent	Consequent
If it’s raining	it’s cloudy

#### **Inverted Conditional (Consequent First)**

Consequent	Antecedent
It’s cloudy	if it’s raining.

Thanks to translation variations, we can’t trust English to mark the antecedent with “if” and consequent with “then”. And thanks to inversion, we can’t trust English to put the antecedent first. Yet proper translation still requires us to tell which part is antecedent, which consequent. With both earlier clues knocked out, translating conditionals from English to the formal language looks practically impossible.

**4. A Rule for Translating Conditionals.** But tucked in our last example of inversion is a simple clue. Note that in the examples above, the **conditional phrase** – “if” – **comes right before the antecedent**, in both standard and inverted conditionals.

**P:** It’s raining    **Q:** It’s cloudy

**Standard Conditional** (Antecedent First)

P Antecedent	Q Consequent
If it’s raining	it’s cloudy

**Inverted Conditional** (Consequent First)

Q Consequent	P Antecedent
It’s cloudy	if it’s raining.

} (P → Q)

This holds for ordinary conditional phrases in general: whether the conditional is standard or inverted, an **ordinary conditional phrase comes right before the antecedent**.

**Standard Conditional**  
(Antecedent First)

**Inverted Conditional**  
(Consequent First)

**Ordinary Conditional Phrases**  
(Before Antecedent)

*If* it's raining, *then* it's cloudy  
*If* it's raining, it's cloudy  
*Provided (that)* it's raining, it's cloudy  
*Assuming (that)* it's raining, it's cloudy

**Ordinary Conditional Phrases**  
(Before Antecedent)

[no inverted form]<sup>2</sup>  
 It's cloudy *if* it's raining  
 It's cloudy *provided (that)* it's raining  
 It's cloudy, *assuming (that)* it's raining

**Exceptional Conditional Phrase**  
(Before Consequent)

It's raining *only if* it's cloudy

**Exceptional Conditional Phrase**  
(Before Consequent)

*Only if* it's cloudy is it raining

And now it's clear why we group “only if” separately: it's exceptional because **“only if” comes right before the consequent.**

**Ordinary conditional phrases** come right  
before the **antecedent**.

**“Only if”** comes right **before the consequent**.

This slim clue will prove sufficient for carving English language conditionals at their joints, and correctly identifying antecedent and consequent.

<sup>2</sup> Recognizing “if... then” as the one English conditional phrase which **can't** be inverted, we understand why, when “if... then” was our only example of a conditional phrase, it appeared the antecedent would always come first: if the only conditional phrase of English were “if... then,” there would be no inverted conditionals. The first complication (translation variations) brought the second (inversion) with it.

**5. Comma Clue, Revisited.** In the previous chapter we noted that the comma was a particularly useful clue for identifying the main break in a sentence. That continues to hold with conditionals, where the gap between antecedent and consequent (in either order) is frequently marked by a comma.

For instance, we identify the conditional phrase “assuming” as the main form phrase in the following sentence, because the comma appears right before that phrase.

**Both** Suki and Neko will go to dinner, **assuming** there's sushi.

Whereas in the next sentence the conditional phrase “if... then” isn’t the main form phrase (that honor going to “but”) – as the comma makes clear.

Elvis isn't employed, **but if** the casinos are hiring **then** he'll work as a blackjack dealer.

But beware: even when a conditional phrase is the main form phrase of the sentence, it often **doesn't** appear at the comma-marked gap – as in the following examples.

If the Bobcats lost, Rex is upset.

**Provided that** the tourists left, Jack went surfing.

**Assuming** there's sushi, **both** Suki **and** Neko will go to dinner.

So while the comma remains an important clue in our toolbox for finding the main form phrase of a sentence, we can't rely on a conditional phrase to show up beside the comma – even when it is the main form phrase. (Instead we may have to appeal to a process of elimination, as in that last example: while “both” appears at the comma break, “both” isn't the sort of form phrase that appears between two parts being glued together.<sup>3</sup>)

<sup>3</sup> These are the same clues applied in our discussion of inversion in 2.5. For example, in the sentence “**Unless** there won’t be sushi, **both** Suki **and** Neko will come to dinner” “both” appears at the comma gap; but since “both” can’t glue left and right parts together, we conclude instead that this sentence is an inverted “unless” sentence. In fact, while we’re counting the above three sentences as un-inverted conditionals, they so perfectly mirror the signs of inversion that perhaps we should count these conditionals

**6. “Otherwise”: A More Complex Form Phrase.** In closing we note a more complex phrasing involving conditionals. The following sentence poses no surprises for current translation methods.

**If** Suki passed the quiz, she’ll get an A in Psychology; **but if** she didn’t pass the quiz she’ll get a B.

We translate the sentence as the conjunction of two conditionals.

**P:** Suki passed the quiz      **Q:** Suki will get an A in Psychology  
**R:** Suki will get a B in Psychology

**If P, Q; but if n’t P R.**

$( (P \rightarrow Q) \wedge (\sim P \rightarrow R) )$

And a slight rewording (with an inverted conditional on the left) makes the same claim.

Suki will get an A in Psychology **if** she passed the quiz, **and** a B **otherwise**.

“Otherwise” here signals the **negation of the previous antecedent** (just like “she didn’t” in the earlier sentence). So, using the same translation key, we translate this sentence the same as the earlier sentence.

**Q if P, and R otherwise.**

$( (P \rightarrow Q) \wedge (\sim P \rightarrow R) )$

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as inverted as well. In that case “Rex is upset **if** the Bobcats lost” would be a ‘standard’ (un-inverted) conditional, while “**if** the Bobcats lost, Rex is upset” would be its inverted counterpart.



Though the following “otherwise” sentence leaves out the middle conjunction phrase entirely, it’s translated the same as the previous two.

**P:** Suki passed the quiz      **Q:** Suki will get an A in Psychology  
**R:** Suki will get a B in Psychology

Suki will get an A in Psychology **if** she passed the quiz; **otherwise** she’ll get a B.

**Q if P; otherwise R.**

$( (P \rightarrow Q) \wedge (\sim P \rightarrow R) )$

Thus we recognize “**otherwise**” as signaling the **conjunction of two conditionals** – where the antecedent of the first conditional returns, negated, as antecedent of the second.

We’ll revisit “other” as a kind of negation phrase in the more complex sentences of Chapter Six.<sup>4</sup>

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<sup>4</sup> Some computer languages use the sentence form “If P then Q else R” which is equivalent to “If P then Q; otherwise R”. As will appear in Chapter Six, “else” likewise acts a kind of negation phrase.

## Summary

### English Conditionals:

- **Ordinary conditional phrases** come right before the **antecedent**
- **“Only if”** comes right before the **consequent**

### Formal Conditionals:

- The **antecedent** goes **before** the arrow
- The **consequent** goes **after** the arrow

### “Otherwise”:

- “If P then Q; otherwise R” is translated as a **conjunction of two conditionals** (where the antecedent of the first conditional returns, negated, as the antecedent of the second conditional).

$$( (P \rightarrow Q) \wedge (\sim P \rightarrow R) )$$