# Conditionals and Cognitive Science

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Karolina Krzyżanowska (MCMP, LMU Munich)



# Conditionals. What are they?



#### Conditionals: indicatives vs. subjunctives

- If Oswald didn't kill Kennedy, someone else did.
- If Oswald had not killed Kennedy, someone else would have.

#### Today's talk will be about indicatives:

#### · If Oswald didn't kill Kennedy, someone else did.

If Oswald had not killed Kennedy, someone else would have.

# Indicative conditionals? What about them?

- truth conditions?
- do they have truth conditions at all?
- assertability conditions?
- acceptability conditions?
- probabilities of conditionals?
- reasoning with conditionals?





# The plan for today

- 1. Some well known problems concerning conditionals
- 2. An example from my own research

Probably the most famous reasoning task ever

#### Wason selection task (1966)



If there is an A on one side, then there is a 3 on the other side.

#### "Deontic" version of the selection task



If a person drinks alcohol, they should be over 18.

It all began in the antiquity...

# Philo of Megara

... Philo says that a true conditional is one which does not have a true antecedent and a false consequent ...

(Sextus Empiricus)



# Diodorus Cronus

... Diodorus defines it as one which neither is nor ever was capable of having a true antecedent and a false consequent...

(Sextus Empiricus)



#### Truth-functional interpretation

• material conditional:  $P \Rightarrow Q$  iff  $\neg P \lor Q$ 

Р	Q	$P \Rightarrow Q$
1	1	1
1	0	0
0	1	1
0	0	1

#### Reasoning with conditionals

- $MP: P \Rightarrow Q, P$ . Therefore Q. valid
- *MT:*  $P \Rightarrow Q, \neg Q$ . Therefore  $\neg P$ . valid

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- *MT:*  $P \Rightarrow Q, \neg Q$ . Therefore  $\neg P$ . valid
- *DA*:  $P \Rightarrow Q, \neg P$ . Therefore  $\neg Q$ . invalid
- $AC: P \Rightarrow Q, Q$ . Therefore P. invalid

# Byrne's suppression task (1989)

If she has an essay to write then she will study late in the library.

She has an essay to write.

Therefore, she will study late in the library.

96% endorsement rate

# Byrne's suppression task (1989)

If she has an essay to write then she will study late in the library.

She has an essay to write.

If the library stays open then she will study late in the library.

Therefore, she will study late in the library.

38% endorsement rate

#### Paradoxes of material implication

- If aubergines are vegetables, badgers are mammals.
- If Maria Skłodowska-Curie was a scientist, 2 + 3 = 5.

Р	Q	$P \Rightarrow Q$
1	1	1

#### Paradoxes of material implication

- If aubergines are mammals, badgers are vegetables.
- If elephants read Aristotle, there are no philosophers.

Р	Q	$P \Rightarrow Q$
0	0	1

#### Paradoxes of material implication

- If aubergines are mammals, eating vegetables is healthy.
- If John is a woman, John is a man.
- If Thomas Mann has never written anything at all, he was a writer.

Р	Q	$P \Rightarrow Q$
0	1	1

#### Alternative accounts

# The Ramsey Test

"If two people are arguing 'If p will q'? and are both in doubt as to p, they are adding p hypothetically to their stock of knowledge and arguing on that basis about q: so that in a sense 'If p, q' and 'If p, ~q" are contradictories. We can say they are fixing their degrees of belief in g given p."



### Truth conditional semantics (Stalnaker 1968, 1984)

• P > Q is true iff Q is true in the closest possible P-world.

Р	Q	$P \Rightarrow Q$
1	1	1
1	0	0
0	1	0 or 1
0	0	0 or 1

# Truth conditional semantics (Stalnaker 1968, 1984)

• P > Q is true iff Q is true in the closest possible P-world.

- Problem:
  - What if P and Q are both true in the actual world?
  - If aubergines are vegetables, Ruth Byrne invented the suppression task.

### Probabilistic accounts

- Conditionals do not have truth conditions, only acceptability conditions (e.g. Edgington 1995)
- The Adams Thesis:  $Ac(P \Rightarrow Q)$  "goes by"  $Pr(Q \mid P)$ .
- Problem:
  - What if both Pr(P) and Pr(Q) are extremely high?
  - If aubergines are vegetables, this fair coin will land heads at least once in the first million tosses.

# So what is it that a conditional conveys?

# Chrysippus

... And those who introduce connection or coherence say that a conditional holds whenever the denial of its consequent is incompatible with its antecedent...

(Sextus Empiricus)



#### Back to Chrysippus...

Conditional is true if and only if it corresponds to a valid argument.



# A linguistic view

✓ There is a large class of indicative conditionals that can be characterised by the existence of an inferential connection between their antecedents and their consequents: inferential conditionals.

(e.g. Dancygier 1998, Sweetser 1990, Declerck & Reed 2001)

# Typology of inferences



# Typology of inferential conditionals (Douven & Verbrugge 2010)



# Definition 1

A sentence "If p, then q" is a deductive inferential (DI) / inductive inferential (II) / abductive inferential (AI) conditional if and only if q is a deductive / inductive / abductive consequence of p.

### Definition 2

A sentence "If p, then q" is a contextual DI / II / AI conditional if and only if q is a deductive / inductive / abductive consequence of { $p, p_1, ..., p_n$ }, with  $p_1, ..., p_n$  being background premises salient in the context in which "If p, then q" is asserted or being evaluated.

# Examples of DI conditionals

• If all Indian Elephants have small ears and Babou is an Indian Elephant, then Babou has small ears.

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• If all Indian Elephants have small ears and Babou is an Indian Elephant, then Babou has small ears.

Context: All Indian Elephants have small ears.

• If Babou is an Indian elephant, then it has small ears.

# Examples of II conditionals

 If 95% of students pass this exam, then you will pass as well.

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 If 95% of students pass this exam, then you will pass as well.

Context: Bernard is a bit of an irregular student: sometimes he works hard, but he can also be lazy. So far he had excellent grades for most courses for which he had worked hard.

• If Bernard works hard for the linguistic course, then he will get an excellent grade for it.

# Examples of AI conditionals

• If Amy is coughing and sneezing, then she caught an infection.

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• If Amy is coughing and sneezing, then she caught an infection.

Context: Bob lives on the 6th floor of an apartment building. The elevator has been broken since earlier this morning. A good friend of Bob's who lives on the third floor hears someone rushing down the stairs. She knows that Bob avoids exercise as much as possible.

• If that's Bob rushing down the stairs, then he is in a hurry.

# Question

• What is the use of such a typology if we cannot tell different kinds of conditionals apart?

Evidentiality in English and in Dutch (Krzyżanowska, Wenmackers, Douven 2013)

# Evidentiality (Aikhenvald 2004)

- A linguistic system that encodes the source of some information
- core vs. extended evidentiality:
  - core: grammatical marking (e.g. prefixes, suffixes, etc.)
  - extended evidentiality: evidential strategies (e.g. lexical markers: "I heard", "allegedly").

#### Basic categories of evidentiality (Willett 1988)



#### Basic categories of evidentiality (Willett 1988)



- Candidates for evidential markers (von Fintel & Gillies 2007):
  - In English: **should, must, probably**.
  - In Dutch: zou moeten, moet, waarschijnlijk.

- Susan studied philosophy. She **should** know who Hegel was.
- Susan studied philosophy. She probably knows who Hegel was.

- **??** Susan just published a book on Hegel. She **should** know who Hegel was.
- **??** Susan just published a book on Hegel. She **probably** knows who Hegel was.

- People who have just entered the building are carrying wet umbrellas. It **must** be raining.
- People who have just entered the building are carrying wet umbrellas. It is **probably** raining.

- ?? I have just got completely wet. It **must** be raining.
- ?? I have just got completely wet. It is probably raining.

- The key is either in my pocket or in the bag. It is not in my pocket, so it **must** be in the bag.
- **??** The key is either in my pocket or in the bag. It is not in my pocket, so it is **probably** in the bag.

- ?? I see that the key is in the bag, so it **must** be in the bag.
- ?? I see that the key is in the bag, so it **probably** is in the bag.

# Questions

- How does adding an evidential marker to an inferential conditional's consequent affect its assertability?
- Are there any systematic differences depending on the type of an inference reflected by a conditional?
- Is the pattern common for different languages?

#### Example stimulus: abductive inference

**Context**: Nelly lives on the sixth floor of an apartment building. The elevator has been broken since earlier this morning. A good friend of Nelly's who lives on the third floor of the same building hears someone rushing down the stairs. She knows that Nelly tends to avoid exercise as much as possible.

#### How assertable are the following conditionals given this context?

(1) If that's Nelly rushing down the stairs, then she is in a hurry.(2) If that's Nelly rushing down the stairs, then she should be in a hurry.(3) If that's Nelly rushing down the stairs, then she must be in a hurry.(4) If that's Nelly rushing down the stairs, then she probably is in a hurry.

### Our expectations

- Negative effect of a marker: incompatibility with the type of an inference.
- Positive or no effect of a marker: compatibility with the type of an inference.

#### Measure

#### **Relative assertability**

# assertability with a marker **minus** assertability without a marker

### English: "should", "must" and "probably"



#### Dutch: "zou moeten", "moet" and "waarschijnlijk"



# Summary of the results

- Both in English and in Dutch:
  - "should" seems to mark the presence of inductive inference.
  - "must" seem marks the abductive inference.
  - Unsurprisingly, "Probably" marks uncertainty.
  - Nothing has a positive effect on the assertability of DI conditionals.
- Plausibility of the typology of inferential conditionals confirmed.

# Conclusion

- Combining methods from different disciplines allows us to look at old problems afresh and find new solutions.
- Empirical data are necessary if we want to develop a descriptively correct theory of conditionals (or any other class of linguistic expressions)
- There is still a lot to be done about conditionals!

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