Enthymemes in Dialogues

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Structured argumentation: An argument consists of a conclusion deductively and/or defeasibly inferred from some premises.

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e.g.

(conclusion)   Take an umbrella with you.

(inference rule)   If it's raining outside, then take an umbrella with you.

(premise)   It's raining outside.

Structured argumentation: An argument consists of a conclusion deductively and/or defeasibly inferred from some premises.

e.g.

(conclusion)   b   Take an umbrella with you.

(inference rule) $a \Rightarrow b$ If it's raining outside, then take an umbrella with you.
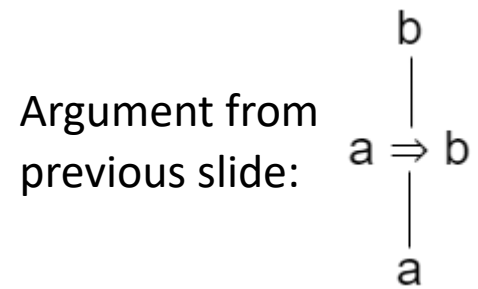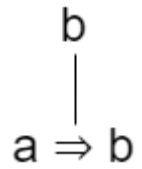
(premise)   a   It's raining outside.

Enthymeme: An argument with incomplete logical structure, i.e. an argument missing either:

1. one (or more) premise(s)

2. one (or more) inference rule(s)

3. the conclusion of the argument
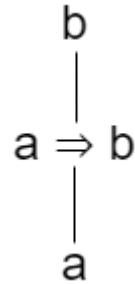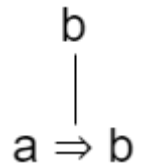
4. a combination of the above

Argument from
previous slide:

$$
\begin{array}{c}
b \\
\mid \\
a \Rightarrow b \\
\mid \\
a
\end{array}
$$

1.

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \end{array}$$

If it's raining outside, then take
an umbrella with you.
Take an umbrella with you.

Argument from
previous slide:

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

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1.

$$b$$
$$|$$
$$a \Rightarrow b$$

If it's raining outside, then take
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Take an umbrella with you.

Argument from
previous slide:

$$b$$
$$|$$
$$a \Rightarrow b$$
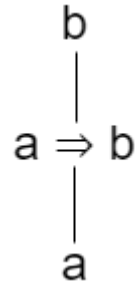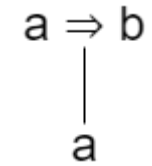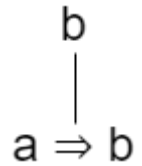$$|$$
$$a$$

2.

$$a \Rightarrow b$$
$$|$$
$$a$$

It's raining outside.
If it's raining outside, then take an
umbrella with you.

Andreas Xydis, Christopher Hampson, Sanjay Modgil, Elizabeth Black

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1.

$$b$$
$$|$$
$$a \Rightarrow b$$

If it's raining outside, then take
an umbrella with you.
Take an umbrella with you.

2.

$$a \Rightarrow b$$
$$|$$
$$a$$

It's raining outside.
If it's raining outside, then take an
umbrella with you.

Argument from
previous slide:

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$

3.

$$b$$

$$a$$

It's raining outside.
Take an umbrella with you.

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Enthymemes in Dialogues

1.

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \end{array}$$

If it's raining outside, then take
an umbrella with you.
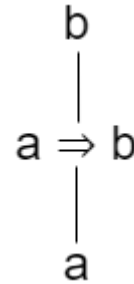Take an umbrella with you.

2.

$$\begin{array}{c} a \Rightarrow b \\ | \\ a \end{array}$$

It's raining outside.
If it's raining outside, then take an
umbrella with you.

Argument from
previous slide:

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

3.

$$\begin{array}{c} b \\ \\ \\ a \end{array}$$

It's raining outside.
Take an umbrella with you.

4.

$$a$$

It's raining outside.
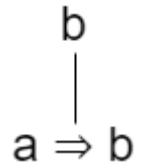
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1.

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \end{array}$$

If it's raining outside, then take an umbrella with you.
Take an umbrella with you.

2.

$$\begin{array}{c} a \Rightarrow b \\ | \\ a \end{array}$$

It's raining outside.
If it's raining outside, then take an umbrella with you.

Argument from previous slide:

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

3.

$$\begin{array}{c} b \\ \\ a \end{array}$$
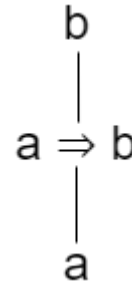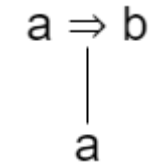
It's raining outside.
Take an umbrella with you.

4.

a   b

It's raining outside.   Take an umbrella with you.

Why important?:

1. Real world dialogues include exchange of enthymemes

2. The use of enthymemes is responsible for many locutions that we see in real world dialogues

Why important?:

1. Real world dialogues include exchange of enthymemes

2. The use of enthymemes is responsible for many locutions that we see in real world dialogues

Relevant works on enthymemes focus on:

1. Shared knowledge between agents

2. Construction/Reconstruction of enthymemes
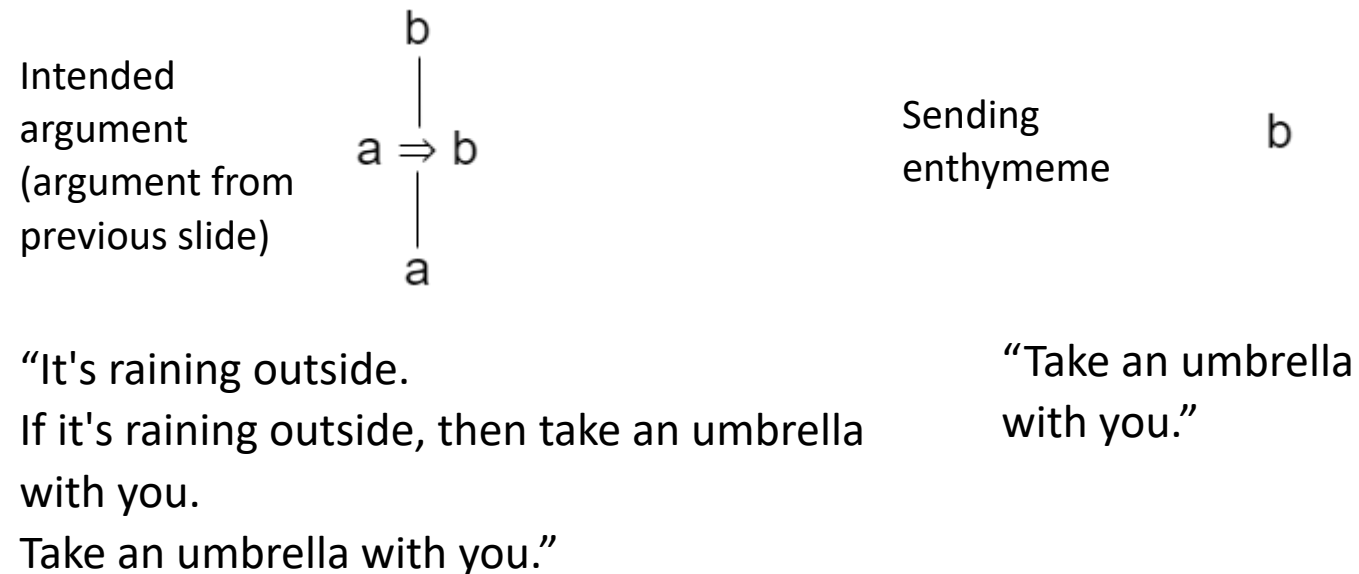
Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

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Intended
argument
(argument from
previous slide)

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$

"It's raining outside.
If it's raining outside, then take an umbrella
with you.
Take an umbrella with you."

Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

Intended
argument
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previous slide)

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$
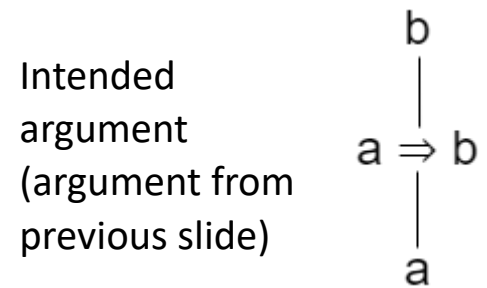
Sending
enthymeme

$$b$$

"It's raining outside.
If it's raining outside, then take an umbrella
with you.
Take an umbrella with you."

"Take an umbrella
with you."

Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

Intended
argument
(argument from
previous slide)

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

Sending
enthymeme

$$b$$

Reconstructed
argument
from receiver

$$\begin{array}{c} b \\ | \\ e \Rightarrow b \\ | \\ e \end{array}$$

"It's raining outside.
If it's raining outside, then take an umbrella with you.
Take an umbrella with you."

"Take an umbrella with you."

"Forecast predicted rain later at night.
If the forecast predicted rain later at night, then take an umbrella with you.
Take an umbrella with you."

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Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

Intended
argument
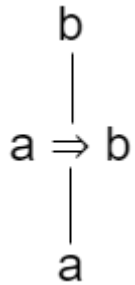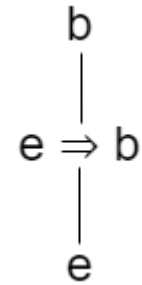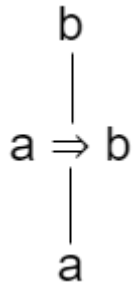(argument from
previous slide)

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$

"It's raining outside.
If it's raining outside, then take an umbrella
with you.
Take an umbrella with you."

Sending
enthymeme

$$b$$

"Take an umbrella
with you."

Reconstructed
argument
from receiver

$$b$$
$$|$$
$$e \Rightarrow b$$
$$|$$
$$e$$

"Forecast predicted rain later at night.
If the forecast predicted rain later at night,
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Take an umbrella with you."

Agent needs to ask for and give clarifications **(backward expansion)**

Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

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(argument from
previous slide)

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$

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If it's raining outside, then take an umbrella
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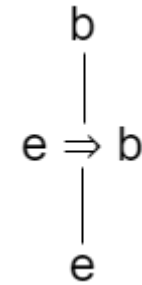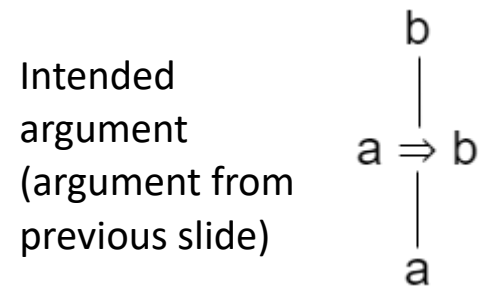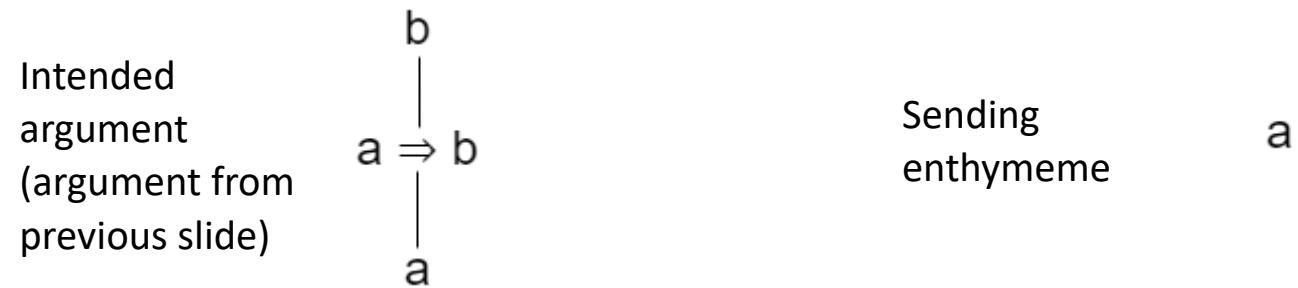# Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

Intended
argument
(argument from
previous slide)

$$b$$
$$|$$
$$a \Rightarrow b$$
$$|$$
$$a$$

Sending
enthymeme

$$a$$

"It's raining outside.
If it's raining outside, then take an umbrella
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Take an umbrella with you."

"It's raining outside."

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Intended
argument
(argument from
previous slide)

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

Sending
enthymeme

a

Reconstructed
argument
from receiver
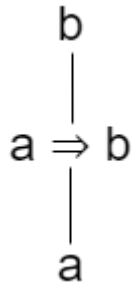
$$\begin{array}{c} c \\ | \\ a \Rightarrow c \\ | \\ a \end{array}$$

"It's raining outside.
If it's raining outside, then take an umbrella with you.
Take an umbrella with you."

"It's raining outside."

"It's raining outside.
If it's raining outside, then don't go outside.
Don't go outside."

Agents need to interpret enthymemes. However, **misunderstandings** can **occur**.

Intended
argument
(argument from
previous slide)

$$\begin{array}{c} b \\ | \\ a \Rightarrow b \\ | \\ a \end{array}$$

Sending
enthymeme

a

Reconstructed
argument
from receiver

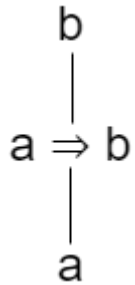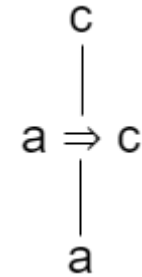$$\begin{array}{c} c \\ | \\ a \Rightarrow c \\ | \\ a \end{array}$$

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Agent needs to ask for and give clarifications **(forward expansion)**

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1.Bob: "You can't afford to eat at a restaurant today."   (**assert** ¬a)

2.Alice: "Why not?" (**why** ¬a)

3.Bob: "Because if you owe money then you probably can't afford to eat at a restaurant today, so you can't afford to eat at a restaurant today." (**because** c⇒¬a; ¬a)

4.Alice: "I made a deal with my creditors."   (**assert** f)

5.Bob: "So what?" (**and-so**)

6.Alice: "So I made a deal with my creditors and if I made a deal with my creditors, I don't need to pay the bills today."
(**hence** f; f ⇒ ¬e)

7.Bob: "Why is that relevant?"   (**what-did-you-think-I-meant-by** c⇒¬a; ¬a)

8.Alice: "I thought that the reason you thought I owe money is because I have bills to pay today."   (**assumed** e ⇒ c; c)

9.Bob: "No! I meant that you owe money because you need to pay Kate back today."   (**meant** p ⇒ c; c)

Sending enthymeme:

¬a

Backward expansion:

¬a
|
c⇒¬a

1.**Bob:** "You can't afford to eat at a restaurant today."   (**assert** ¬a)

2.**Alice:** "Why not?" (**why** ¬a)

3.**Bob:** "Because if you owe money then you probably can't afford to eat at a restaurant today, so you can't afford to eat at a restaurant today." (**because** c⇒¬a; ¬a)

4.**Alice**: "I made a deal with my creditors."   (**assert** f)

5.**Bob**: "So what?" (**and-so**)

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(**hence** f; f ⇒ ¬e)

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8.**Alice**: "I thought that the reason you thought I owe money is because I have bills to pay today."   (**assumed** e ⇒ c; c)

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Sending enthymeme:

$$f$$

Forward expansion:

$$f \Rightarrow \neg e$$
$$|$$
$$f$$

1.**Bob:** "You can't afford to eat at a restaurant today."   (**assert** ¬a)

2.**Alice:** "Why not?" (**why** ¬a)

3.**Bob:** "Because if you owe money then you probably can't afford to eat at a restaurant today, so you can't afford to eat at a restaurant today." (**because** c⇒¬a; ¬a)

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9.**Bob**: "No! I meant that you owe money because you need to pay Kate back today."   (**meant** p ⇒ c; c)

Locution	Meaning
assert	Assert an enthymeme
why	Question a particular element of a previous enthymeme, which is a request for the other participant to provide a backward expansion on that element.
because	Provide a backward expansion on a questioned element.
and-so	Request a forward expansion of a previous enthymeme.
hence^x x∈{eq, fw}	Provide a forward expansion of a previous enthymeme.
w.d.y.t.i.m.b.	Check the other participant's understanding of an enthymeme by asking "what did you think I meant by…".
assumed^y, y∈{eq, bw, fw}	Provide their own interpretation of an enthymeme.
meant^y, y∈{eq, bw, fw}	Correct the other participant's interpretation of an enthymeme.
agree^y, y∈{eq, bw, fw}	Confirm the other participant's interpretation of an enthymeme.
stop	Show the agent's intention to stop the dialogue.

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Conclusion:

1. Expand the set of locutions which handles the use of enthymemes

2. Protocol of dialogue that accounts for enthymemes

Future work:

1. How an argument framework, which include enthymemes, can be constructed based on locutions moved during a dialogue (i.e. <u>dialogue framework to evaluate enthymemes</u>)

2. <u>Correspondence</u> between acceptability of enthymemes in <u>dialogue framework</u> and the <u>Dung argument framework</u> constructed by the contents of the moves made in the dialogue, when participants play <u>logically perfectly</u>[1]

Thank you!

Any Questions?