Introducing Dialogue Games

Paul Piwek

The Open University, UK

Who and where from?

- Lecturer in Computing
- Research area: Dialogue modelling and Natural Language Generation
- Institution: The Open University
  - Open Supported Learning
  - Largest University in Europe: 150,000 undergraduate and 30,000 graduate students
  - 13 regional centres and main campus in *Milton Keynes*


Shetland Islands
Orkney Islands
Hebrides
Scotland
Aberdeen
Dundee
Edinburgh
Glasgow
Northern Ireland
Belfast
Newcastle upon Tyne
Isle of Man
Manchester
England
Wales
Birmingham
London
Cardiff
Bristol
Dover
Southhampton
Portsmouth
Guernsey
Jersey


Shetland Islands
Orkney Islands
Hebrides
Scotland
Aberdeen
Dundee
Edinburgh
Glasgow
Northern Ireland
Belfast
Newcastle upon Tyne
Isle of Man
Manchester
England
London
Bristol
Dover
Portsmouth
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BIRMINGHAM
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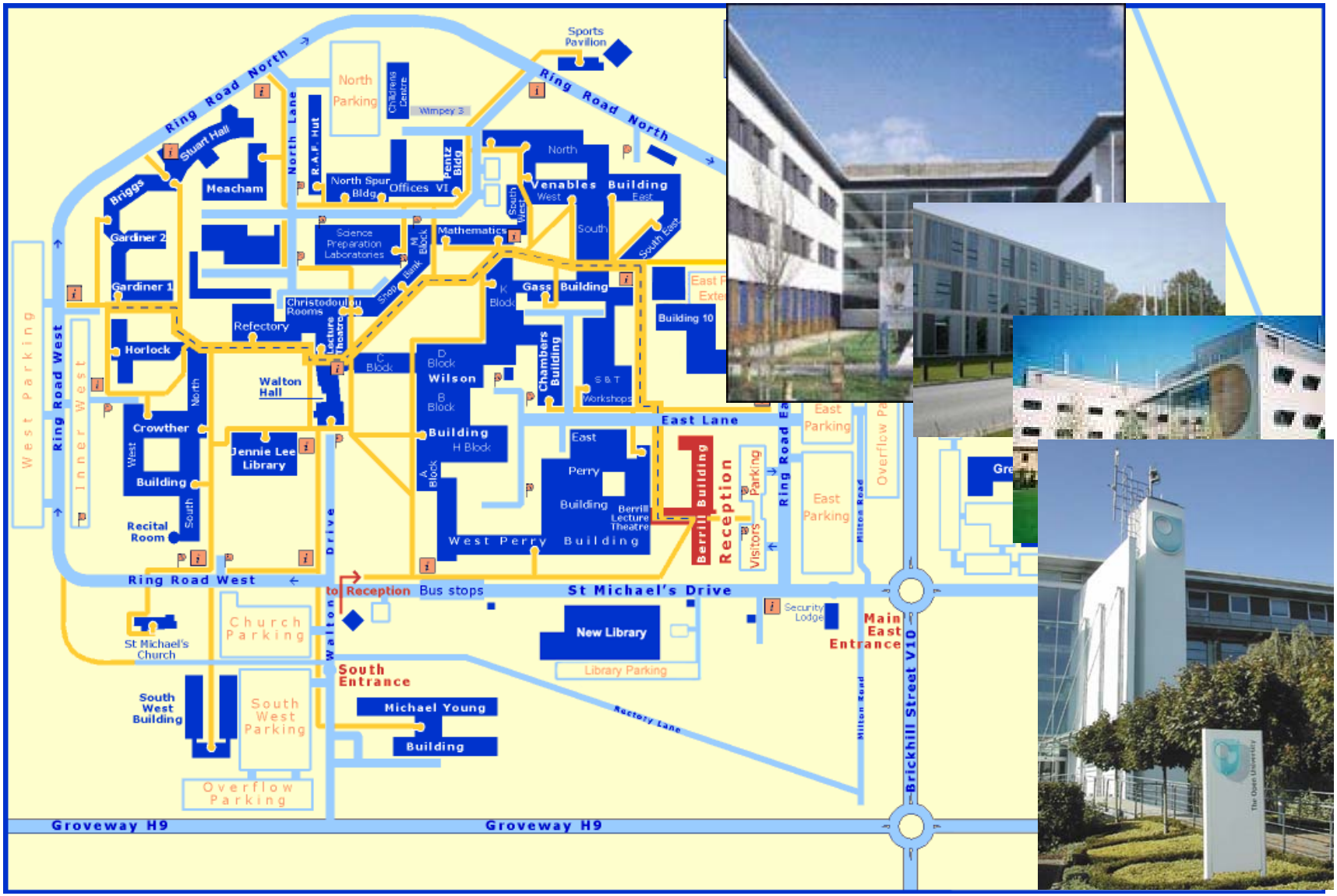
Walton Campus – Milton Keynes



Who and where from?

Centre for
Research in Computing

Institute for Educational Technology

Knowledge Media Institute (KMI)

Computing Department

Natural Language Processing Group

Natural Language Generation Group

Academic Staff: **Prof. Donia Scott**
Dr. Richard Power,
Dr. Paul Piwek

4 Research Fellows, 2 Programmers

2 PhD students

Course Plan

- **Today**:
  - Why study dialogue?
  - What is a dialogue game?
  - Historical overview
- **Tomorrow**:
  - Goal-directed dialogue game for software agents
  - Revisiting the very notion of a dialogue game: Some problems and limitations.
- **Friday**:
  - Open issues/challenges and demos

Learning Outcomes

- Survey the historical landmarks of dialogue game research.
- Overview of different types and diversity of dialogue games.
- Analyse and criticize an argumentative dialogue game.
- Analyse and criticise a goal-directed dialogue game.
- Discuss some of the outstanding issues and new applications in dialogue game research.

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
  - Face-to-face conversation is the basic and primary use of language (Fillmore, 1981):
    - Universal to human societies (compare with written language, phone)
    - Commonest setting (compare lectures, courtroom trails, …)
    - Doesn't require special skills (no schooling)
    - Basic setting for children's acquisition of their first language
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
  - See Linguistics (psycholinguistics)
  - Also: some have argued (Lev Vygotsky) that thought develops socially through interaction
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
  - Dialogue as foundation for logical proof
  - Dialogue rules for delimiting correct argumentative moves
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**

Why study dialogue?

- **Linguistics**
- **Psychology**
- **Philosophy (Logic)**
- **Computer Science**
  - Natural Human-Computer Interfaces (using voice and gesture)
  - Computer-mediated Communication (e.g., translation devices)
  - Artificial Intelligence

Browse products: 11266 products

- NEW! New products!
- Bathroom
- Beds & mattresses
- Bookcases & storage
- Children's IKEA
- Clothes storage
- Cookware
- Decoration
- Floors
- For the pets
- Furniture care
- Hall & entrance
- Kitchen
- Lighting
- Secondary storage
- Sofas & armchairs
- Summer
- Tables & chairs
- Tableware
- Textiles & rugs
- Tv & media solutions
- Work area

Search

Check stock availability

IKEA

Firs

Ret

Cor

IKEA Help Centre

You just said : I would like to buy a bookcase.

Please have a look at the Bookcases Subcategory.

Turn sound on

Go

Close

Why study dialogue?

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  - Artificial Intelligence

Turing Test

- 1950 paper by Alan Turing (1912 - 1954) ‘Computing Machinery and Intelligence’
- **Imitation Game**: a man and a woman go into separate rooms, and guests try to tell them apart by writing a series of questions and reading the typewritten answers sent back. In this game, both the man and the woman aim to convince the guests that they are the other.
- **Turing imitation game**: Which of two agents is human and which is a computer?
- **Aim**: practical determination of intelligence through behaviour

Loebner Competition 1991

- Limiting the topic: The topic of the conversation was to be strictly limited, both for the contestants and the confederates. The judges were required to stay on the subject in their conversations with the agents.

- Limiting the tenor: Further, only behavior evinced during the course of a natural conversation on the single specified topic would be required to be duplicated faithfully by the contestants.

- In 2007 the Judges will be required to start the conversations. Entries will be expected to respond to the judges' initial comment or question. There will be no restrictions on what names etc the entries, humans, or judges can use, nor any other restrictions on the content of the conversations.

http://www.loebner.net/Prizef/loebner-prize.html

Alice and Jabberwacky

ALICE:	Are you alive?
Jabberwacky:	Perhaps.
A:	Why the uncertain tone?
J:	Everything is uncertain except for five facts.
A:	The whole universe?
J:	And we both might just be some ones and zeros in the computer memory.

Dialogue Game - Definition

A *dialogue game* is a more or less formalized set of rules that describe or regulate the conduct of the participants of a dialogue.

Typically, a dialogue game specifies:

- Participants
- Initial situation/Starting position
- Goal situation(s)/Purpose
- Locutions
- Rules and roles: prohibitions, entitlements, abilities, …

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental** For a specific external purpose.
- **Normative**
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**: use dialogue games to specify how human-human dialogue ought to be conducted.
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive** use dialogue games to model naturally occurring human-human dialogue.
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**

Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**: “A formal approach, […] consists in the setting up of simple systems of precise but not necessarily realistic rules, and the plotting of the properties of the dialogues that might be played out in accordance with them.” (Hamblin, 1970:256)

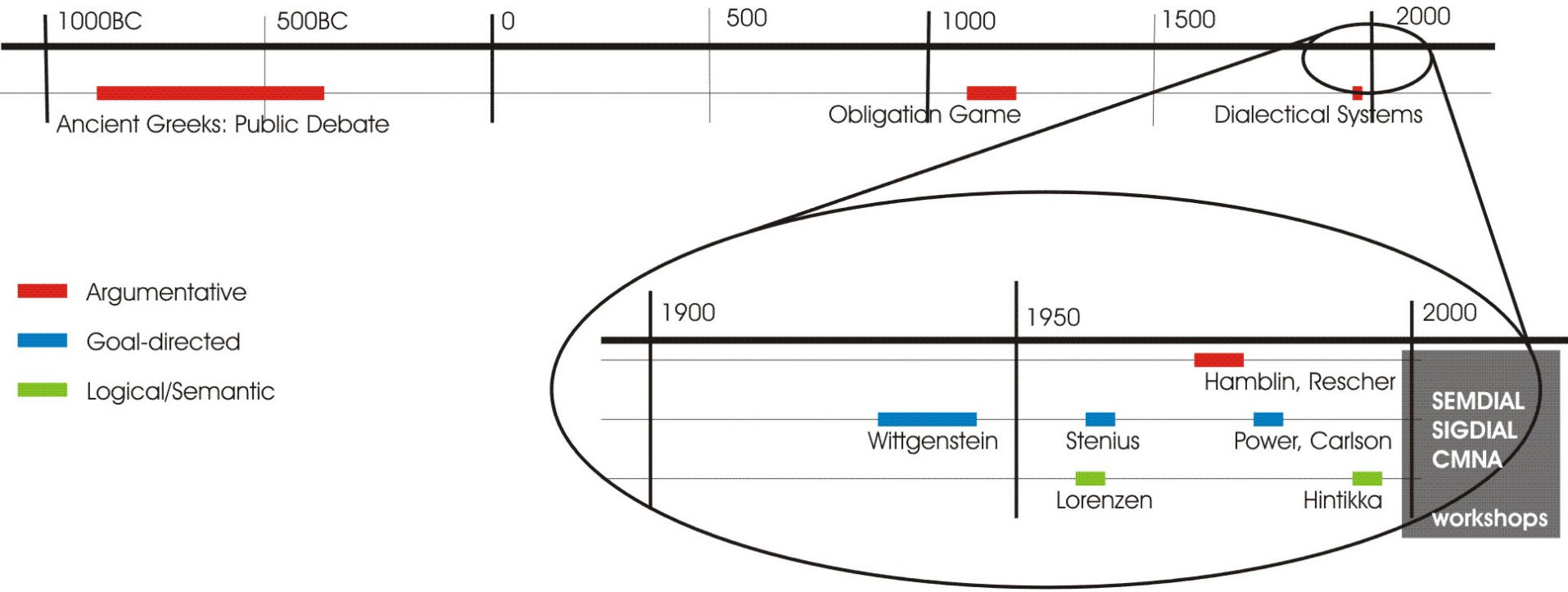
Dialogue Game - Purposes

- **Instrumental**
- **Normative**
- **Descriptive**
- **Formal**: “[not] making any claim that it conformed to something in the real world. It is simply described and then whatever similarities exist between it and reality will reveal themselves. This is no defect in the model. [...] What Boltzman accomplished by this means was to keep his explanation undefiled. There is no temptation to counterfeit reality, for the model is, so to speak, given once and for all, and it can be seen how far it agrees with reality. And even if it does not, it still retains its value.” (Waismann, 1965:77)

Dialogue Game - Participants

- **Human – Machine** dialogue games
- **Human – Human** dialogue games
- **Machine – Machine** dialogue games

Dialogue Game - Chronology

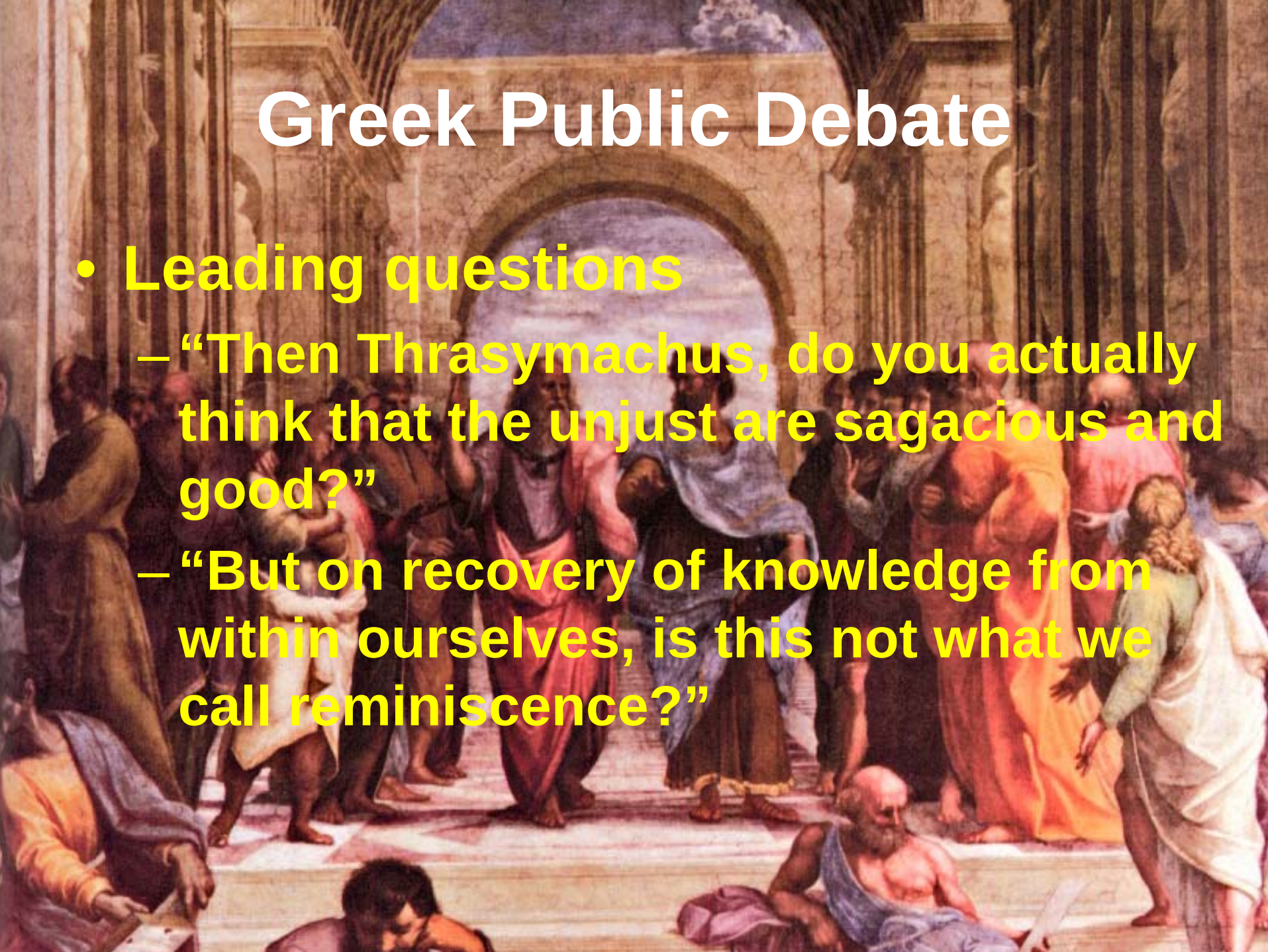


Greek Public Debate

- Ancients Greeks: 800 – 300 BC
- Plato's (earlier) dialogues
- Aim: search for philosophical truth; discovering the essence of some concept: virtue, the State, number, …

Greek Public Debate

- **Participants:**
  - **Questioner: no commitments (but leading questions)**
  - **Answerer**
  - **Onlookers: ultimate arbiters (majority opinion)**



Greek Public Debate

- Leading questions
  - "Then Thrasymachus, do you actually think that the unjust are sagacious and good?"
  - "But on recovery of knowledge from within ourselves, is this not what we call reminiscence?"

Greek Public Debate

- **Participants:**
  - **Questioner: no commitments (but leading questions)**
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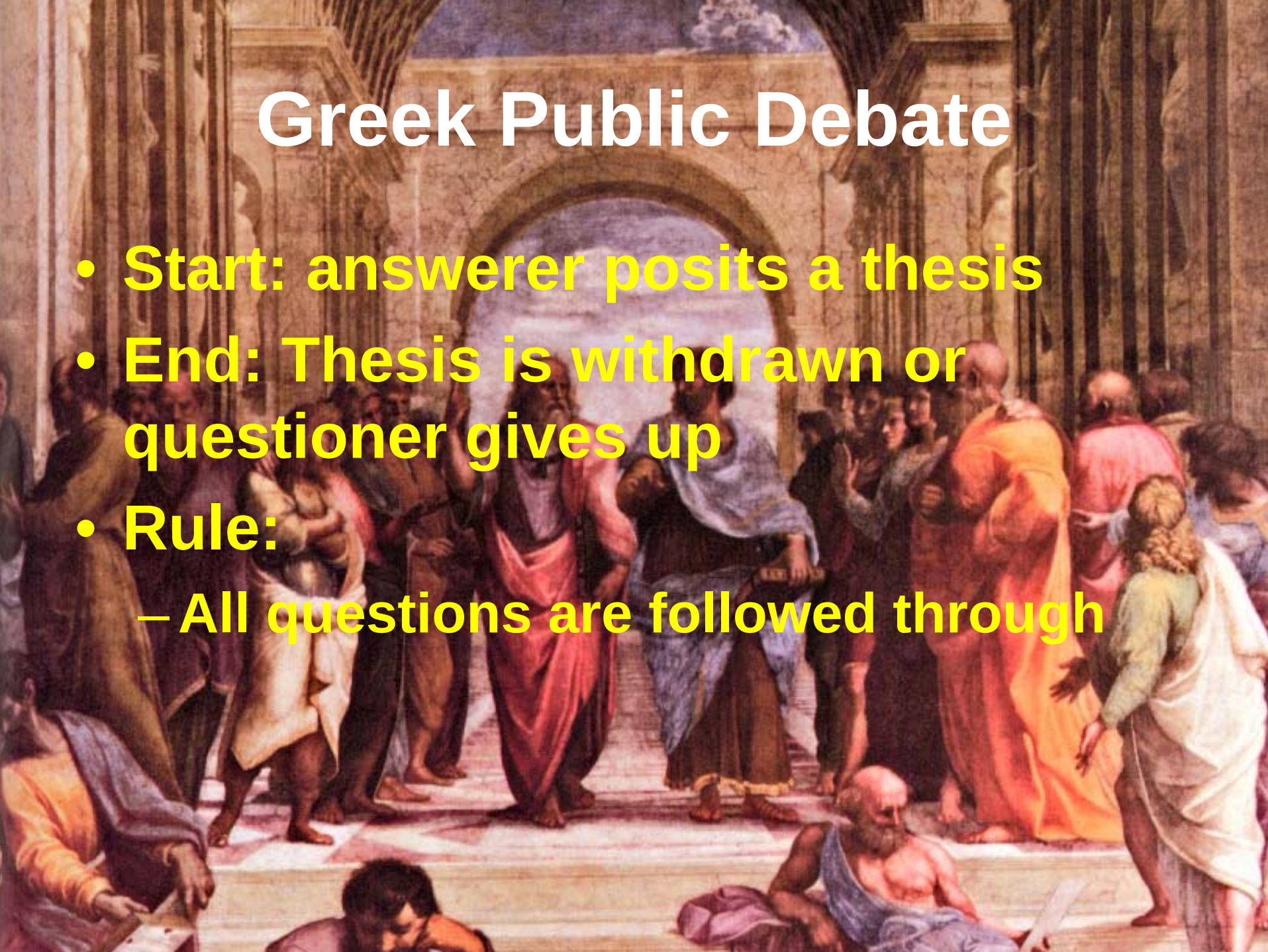
  - **Onlookers: ultimate arbiters (majority opinion)**

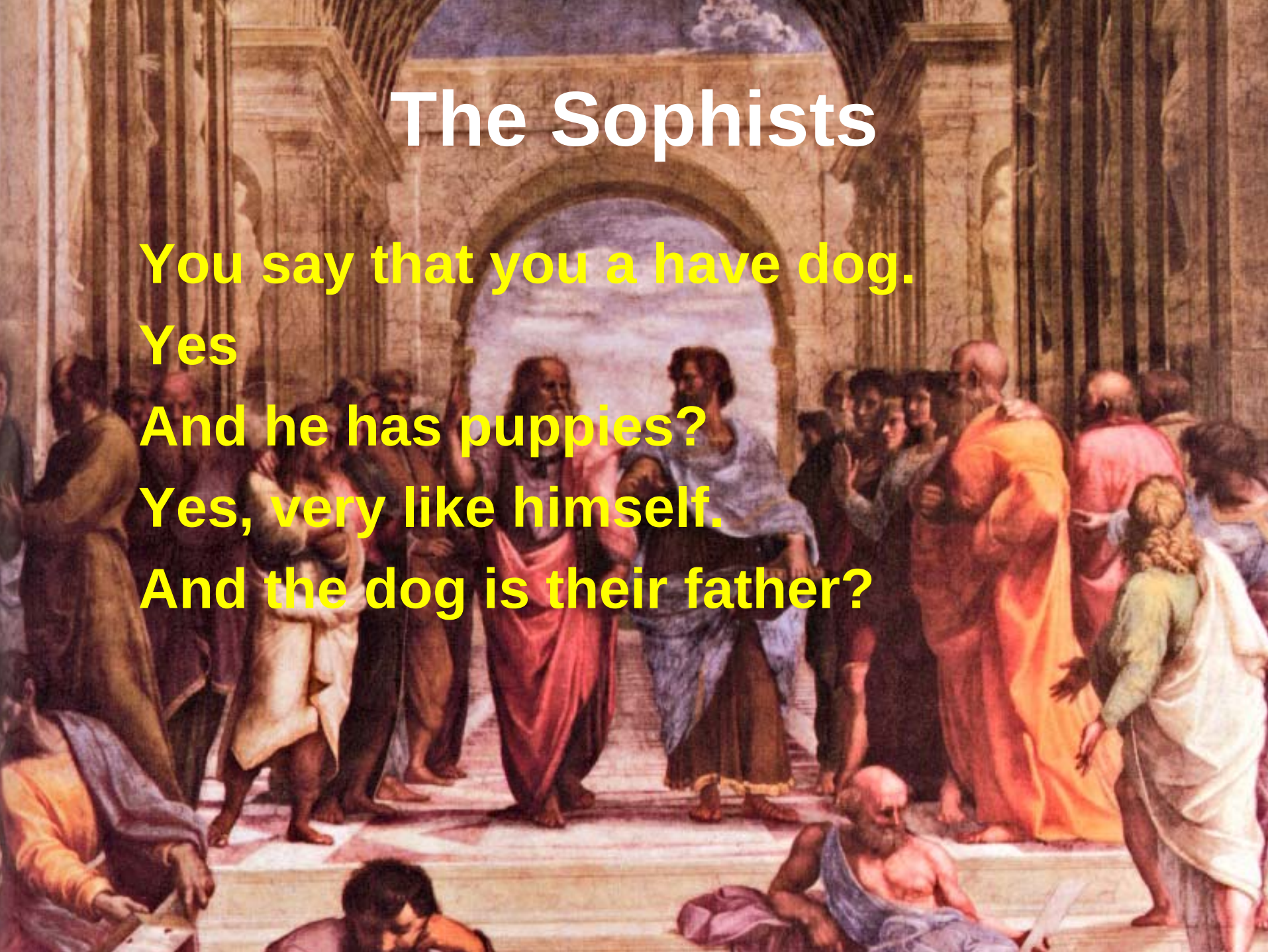


Greek Public Debate

- Start: answerer posits a thesis
- End: Thesis is withdrawn or questioner gives up
- Rule:
  - All questions are followed through

Greek Public Debate

- Ryle (1966): staged and improvised dialogues were common; some of Plato's dialogue were written for performance at the Olympic games



The Sophists

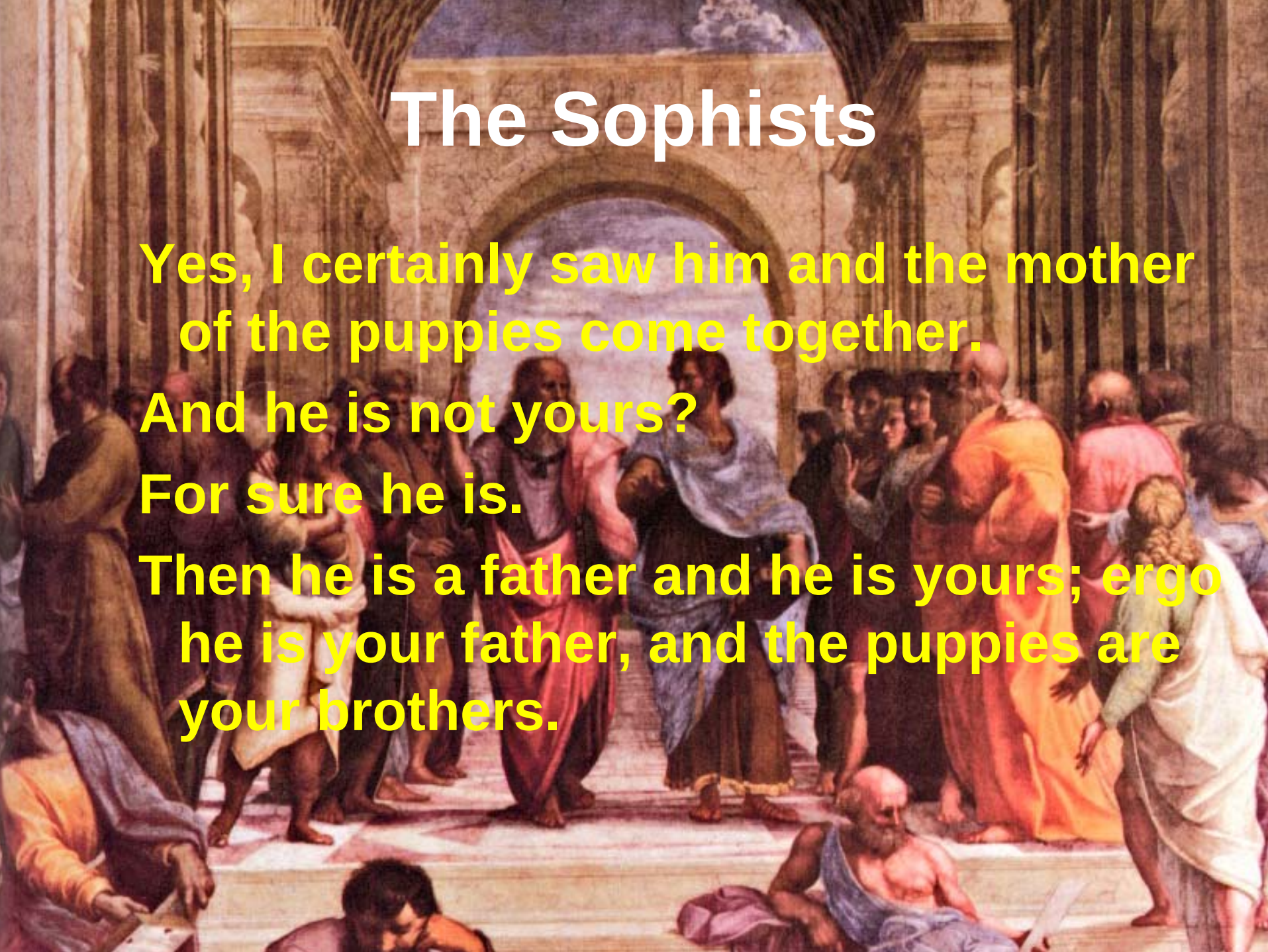
You say that you a have dog.

Yes

And he has puppies?

Yes, very like himself.

And the dog is their father?



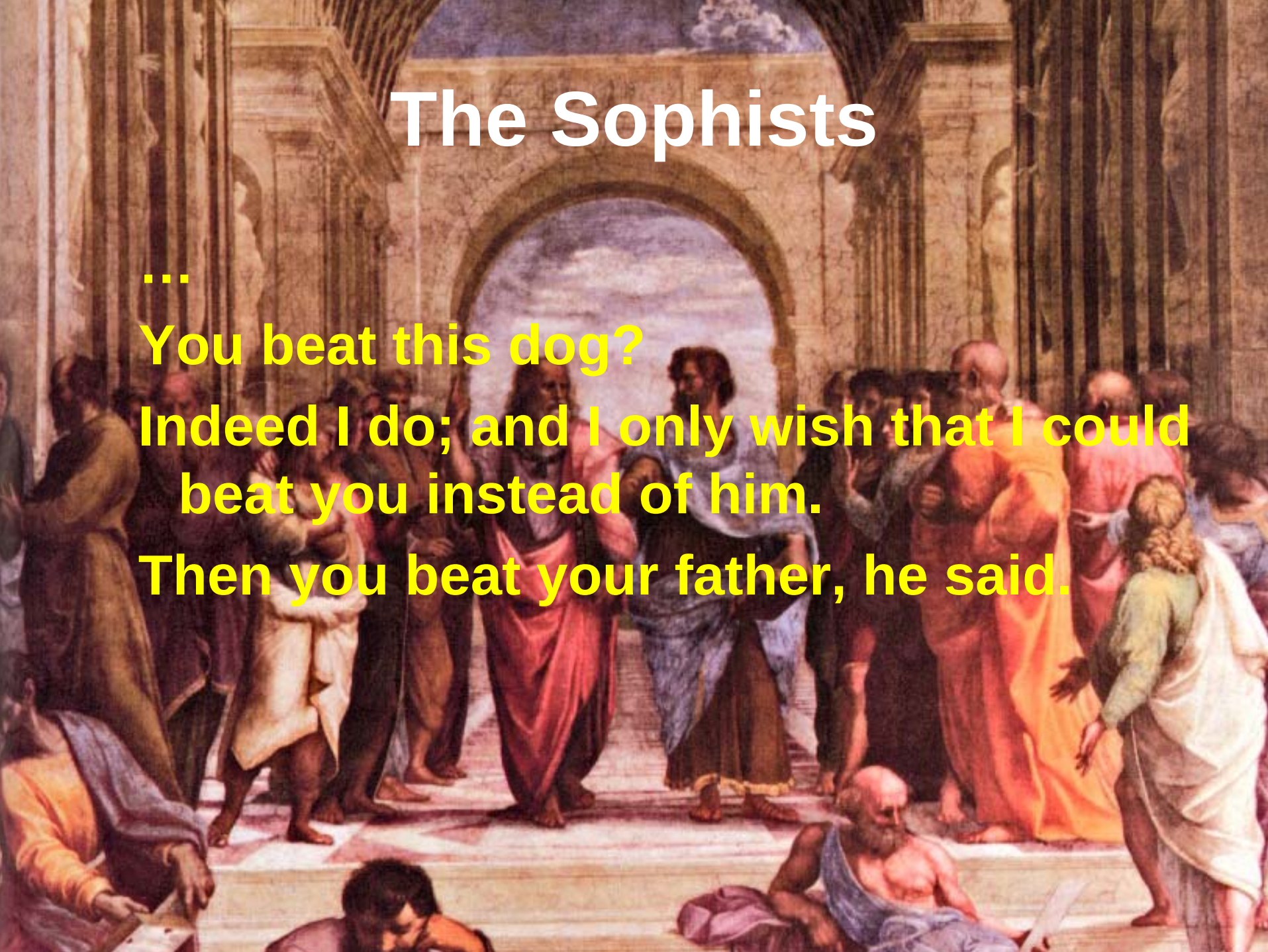
The Sophists

Yes, I certainly saw him and the mother of the puppies come together.

And he is not yours?

For sure he is.

Then he is a father and he is yours; ergo he is your father, and the puppies are your brothers.



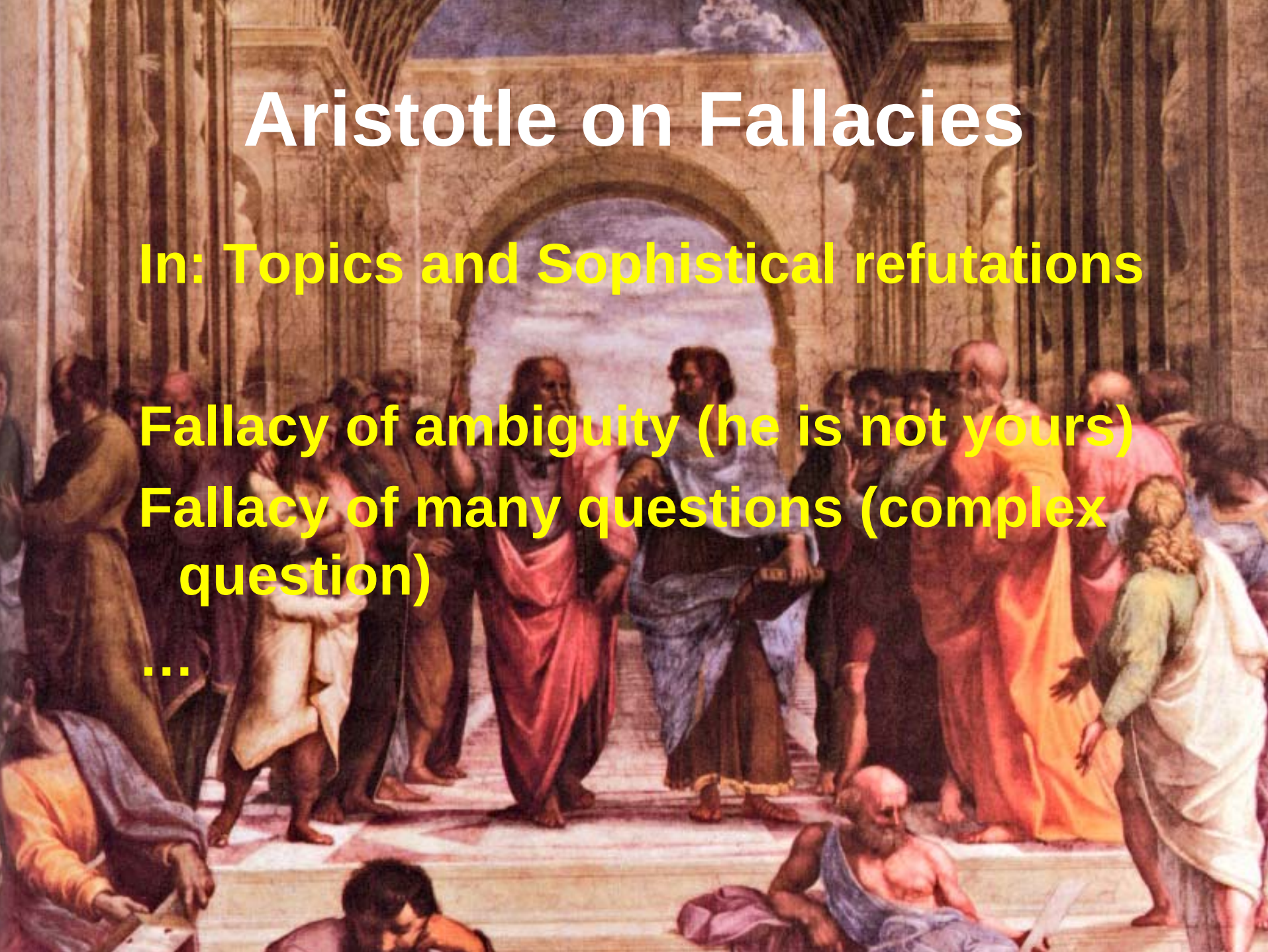
The Sophists

...

You beat this dog?

Indeed I do; and I only wish that I could beat you instead of him.

Then you beat your father, he said.



Aristotle on Fallacies

In: Topics and Sophistical refutations

Fallacy of ambiguity (he is not yours)

Fallacy of many questions (complex question)

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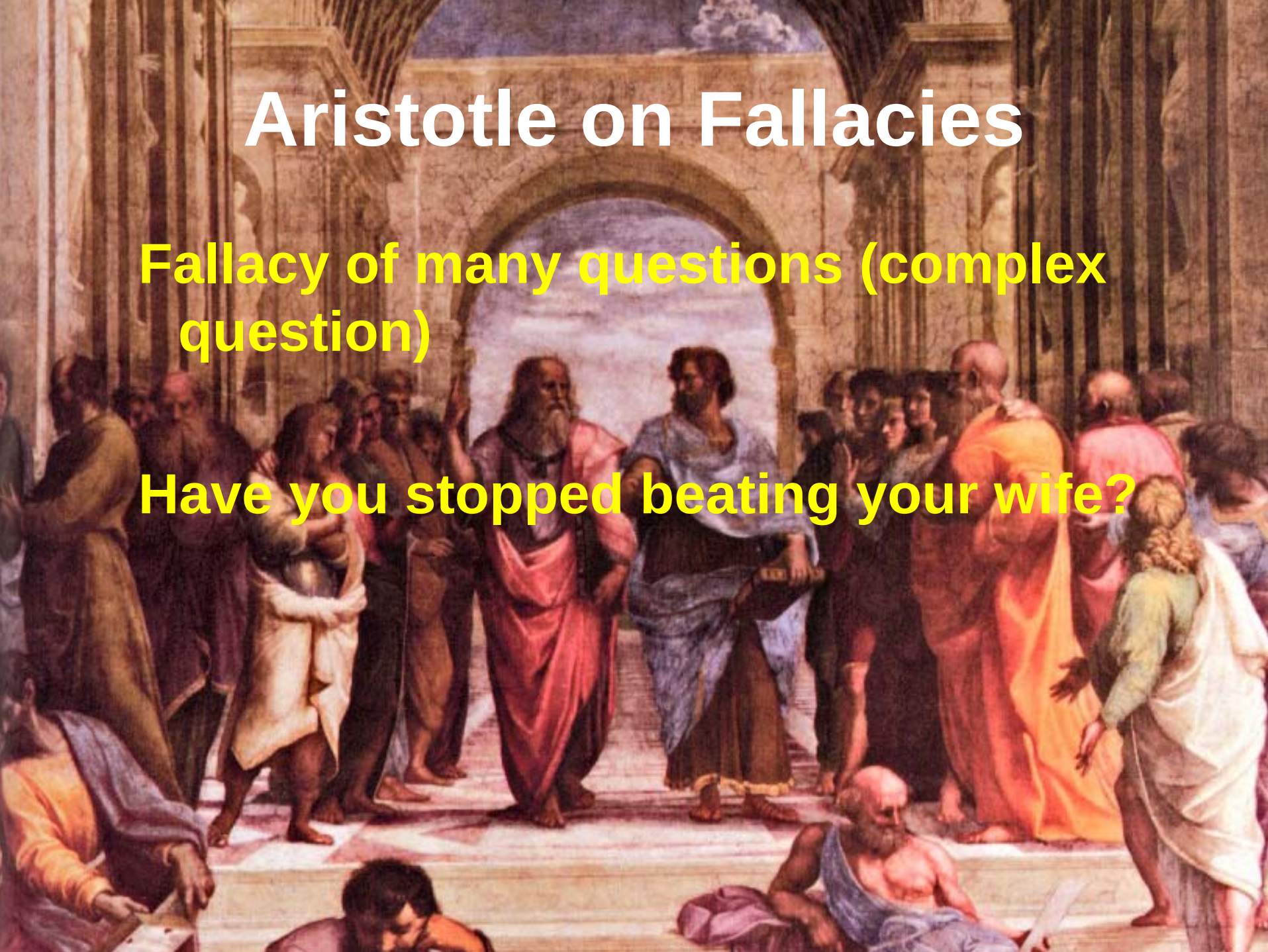
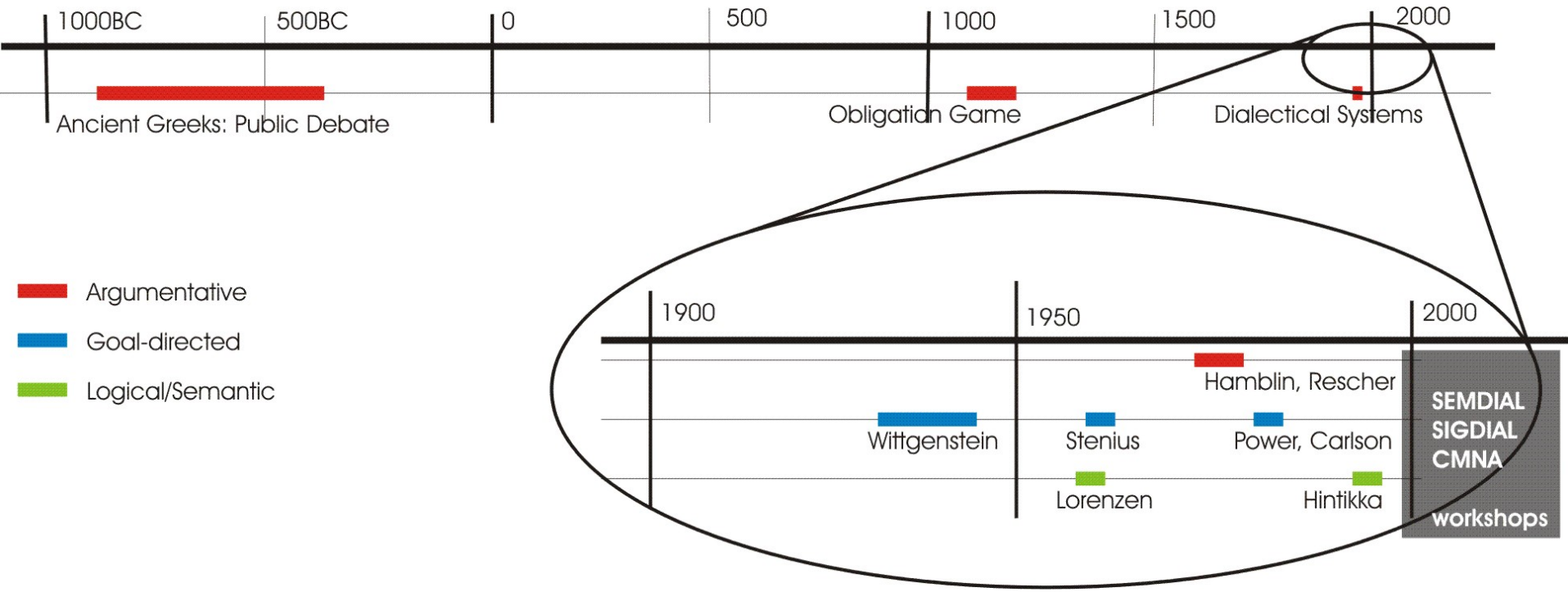


Aristotle on Fallacies

Fallacy of many questions (complex question)

Have you stopped beating your wife?

Dialogue Game - Chronology



Obligation Games

- Medieval disputation format (13th and 14th century)
- Various versions – motivation controversial
  - Counterfactual (“what if”) reasoning
  - Related to modern thesis defence
- Standard Theory: Walter Burley

Obligation Games - Positing

- Participants:
  - Opponent
  - Respondent
- Start: opponent begins with “I posit that P” (positum)
- End/pause: when opponent says “Cedat tempus” (The time is up!/Time out!)
- Result: what has been accepted

Obligation Games - Positing

- Rules:
  - Respondent's first move: "I admit it" (if P contingent) or "I deny it".
  - Opponent's subsequent moves: propose propositions $Q_1 \ldots Q_n$ one after another (propositums).
  - Respondent:
    1. **accept Q_k** IF Q_k follows from P $Q_1 \ldots Q_{k-1}$;
    2. **deny Q_k** IF *not* Q_k follows from P $Q_1 \ldots Q_{k-1}$;
    3. **accept Q_k** IF neither 1 nor 2 applies (irrelevance) and respondent knows Q_k is to be true ;
    4. **deny Q_k** IF neither 1 nor 2 applies and respondent knows Q_k to be false ;
    5. **doubt Q_k** IF neither of 1, 2, 3, and 4.
  - Opponent can suspend/end with "cedat tempus".

Obligation Games - Example

O: Every human walks

R: Admit [contingent positum]

O: You are a human

R: Accept [irrelevant, true]

O: You walk

R: Accept [follows]

Obligation Games - Example

O: Mick Jagger doesn't play with the Rolling Stones

R: Admit [contingent positum]

O: Keith Richards plays with the Rolling Stones

R: Accept [irrelevant, true]

O: Jagger and Richards play in the same band

R: Deny [incompatible]

If Mick Jagger didn't play with the Rolling Stones, he would not be playing in the same band as Keith Richards.

Obligation Games - Example

O: Mick Jagger doesn't play in the Rolling Stones

R: Admit [contingent positum]

O: Mick Jagger and Keith Richards play in the same band.

R: Accept [irrelevant, true]

O: Keith Richards doesn't play with the Rolling Stones.

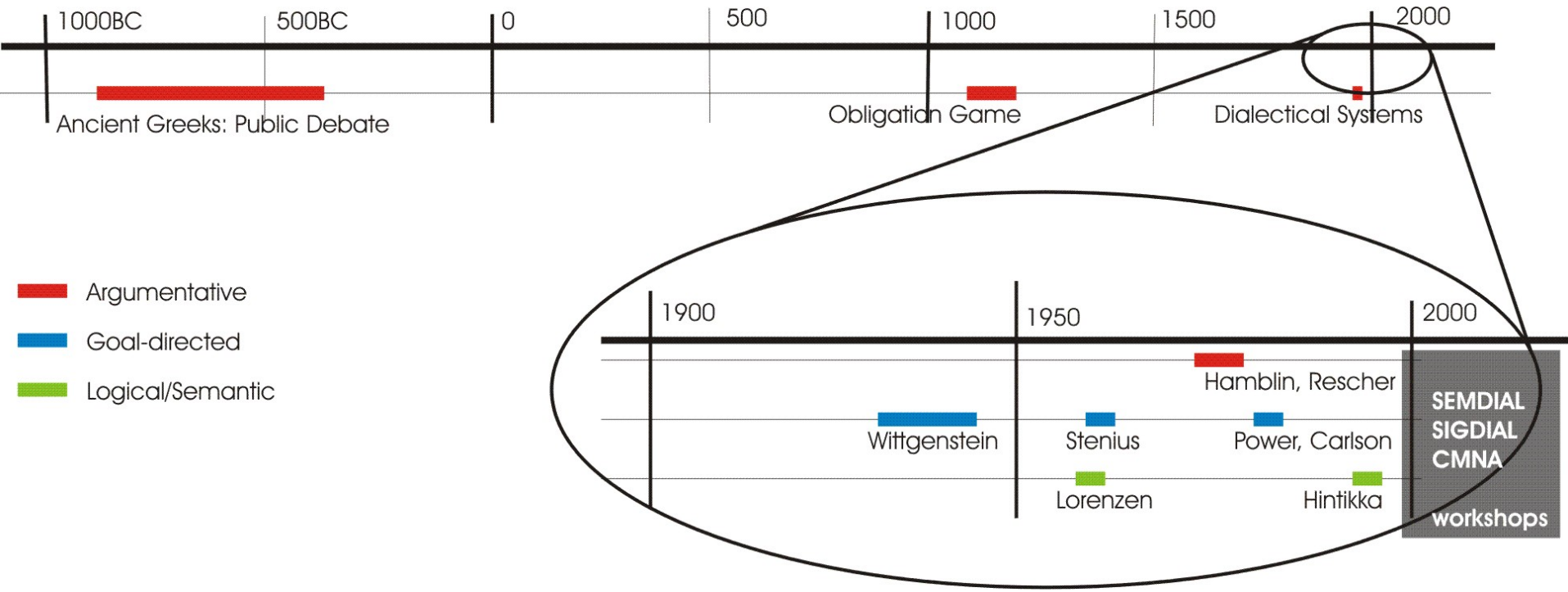
R: Accept [follows]

If Mick Jagger didn't play in the rolling stones, neither would Keith Richards.

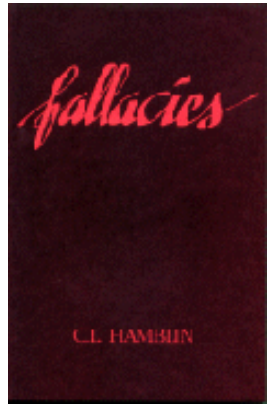
Obligation Games - Commitment

- The respondent can be seen as building up a store of commitments which s/he has to take into account when responding.
  - Rule: If the current propositum is relevant to the commitments (it or its negation follows from them) respond accordingly
  - Rule: If the current propositum is irrelevant, respond according to the actual state-of-affairs.

Dialogue Game - Chronology



C.L. Hamblin



- 1970 book “Fallacies”
- Formal dialectic
- “[…] there are prevalent but false conceptions of the rules of dialogue, which are capable of making certain argumentative moves seem satisfactory and unobjectionable when, in fact, they conceal and facilitate dialectical malpractice.”

Dialectical System

- A regulated dialogue or family of dialogues
- Participants + Rules which govern from and content of what has been said relative to the dialogue history
- Commitment-stores: “running tally of a person’s commitments”
- Rules: prescribe, prohibit or permit
- Avoid permissive rules: any linguistic act, *locution*, that not prohibited is permitted.

Dialectical System

- Locutions: statements and questions
- Assume polite turn-taking
- Rule form: “If C is the case, sentences of the set S are prohibited for person P”
- C is a feature of the dialogue history
- Distinguish: rule-language and object-language

Dialectical System

- Rule-consistent: no situation in which a locution is both permitted and prohibited
- Semantically consistent: participants can’t be forced unconditionally to utter a contradiction

Why-Because with questions

- Participants: W (white) and B (black)
- W moves first
- Commitment stores C(W) and C(B)
- Initial C(W) and C(B) contain shared axioms

Why-Because with questions

- Statement language for expression $S, S_1, \ldots$
- Locutions
  - Statement S
  - Statements S_1, S_2
  - No commitment $S_1, \ldots, S_n$
  - Question $S_1, \ldots, S_n$?
  - Why S? provided S is not a substitution instance of an axiom
  - Resolve S

Why-Because with questions

Syntactical rules (independent of commitment stores):

- $\mathcal{S}1$. One locution at a time, exception `No commitment' + `Why'
- $\mathcal{S}2$. After `Question $S_1,\ldots,S_n$':
  - `Statement not (S_1 or … or S_n)' OR
  - `No commitment S_1 or … or S_n' OR
  - `Statement $S_1$' or `Statement S_2' or … OR
  - 'No commitment $S_1,\ldots,S_n$'

Why-Because with questions

Syntactical rules (independent of commitment stores):

- $\mathcal{S}$3. After `Why S_1?':
  - 'Statement not S_1' OR
  - 'No commitment S_1' OR
  - `Statement S_2' with S_2 equal by definition to S_1
  - 'Statements S_2, If S_2 then S_1' for any `S_2'

Why-Because with questions

Syntactical rules (independent of commitment stores):

- $\mathcal{S}4$. 'Statements S_1, S_2' may not be used except as in the last clause of $\mathcal{S}3$.
- $\mathcal{S}5$. After `Resolve S':
  - 'No commitment S' OR
  - 'No commitent not S'

Why-Because with questions

Commitment-store operation

- $\mathcal{C}1$. Statement S leads to addition of S to the speaker's and the hearer's commitment store. Exceptions (hearer): next locution of hearer is 'not S' or 'no commitment S' or 'Why S?' (but S is added as soon as the reasons for it are accepted).
- $\mathcal{C}2$. Same as $\mathcal{C}1$, but for Statement S_1,S_2

Why-Because with questions

Commitment-store operation

- $\mathcal{C}$3. `No commitment S_1,…,S_n' deletes commitments from speaker's commitment store (unless they are axioms)
- $\mathcal{C}$4. 'Question S_1,…,S_n' places 'S_1 or…or S_n' in the speaker's store (unless already there) and in the hearer's store unless followed by `Statement not S_1 or…or S_n' OR 'No commitment S_1 or…or S_n'.
- $\mathcal{C}$5. 'Why S?' leads to `S' in hearer's store unless already there or he replies 'Statement not S' OR 'No commitment S'.

Example dialogue

1. W: Question A, not A?
2. B: Statement A
3. W: Why A?
4. B: Statement X, X implies A
5. W: Question Z, not Z?

Improving quality of dialogues

- Rules so far: minimum/define scope of the system
- Further rules: framed in terms of commitments

Many questions

- W: Did you stop beating your wife
- W: Question Beat wife, Stopped beat wife

- B: I won’t comment on whether I beat my wife or stopped beating her.
- B: No commitment BW or SBW

- B: Neither am I beating my wife nor did I stop beating her.
- B: Statement not (BW or SBW)

Many questions

- ‘Question S_1,…,S_n?’ may occur only when S_1 or … or S_n is already a commitment of both speaker and hearer.

Statements/Questions

- **Assertions**: ‘Statement S’ may not occur if S is already commitment of the speaker or the hearer.
- **Inquiries**: `Question S_1,…,S_n’ may not occur if any of S_1,…,S_n is already a commitment of speaker or hearer.

W: Question S,S’?
B: Statement S
W: Question S,S’?
B: Statement S
…

The whole truth

W: Who walks? (Question John walks, Mary walks, Peter walks)

B: John walks

…

Burden of Proof

W: Why S?

B: Why not S?

W: Statement S

B: Statement S’

W: No commitment S

B: Why S?

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  - Revisiting the very notion of a dialogue game: Some problems and limitations.
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  - Open issues/challenges and demos