

Lecture 35  
Lewis on Theoretical Terms and Realizations

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- Previous classes discussed a book of Carnap's published 1966.
- In 1970, David Lewis (PhD Harvard 1967) published "How to Define Theoretical Terms." It begins:

*Most philosophers of science agree that, when a newly proposed scientific theory introduces new terms, we usually cannot define the new terms using only the old terms we understood beforehand. On the contrary, I contend that there is a general method for defining the newly introduced theoretical terms. (427)*

We'll discuss Lewis's paper in this and the following class.

# T-terms and O-terms

## Carnap's definitions

- O-terms are observation terms. They designate observable things, properties, or relations. Examples: "blue," "hard," "hot," "temperature of 80 degrees centigrade."
- T-terms are theoretical terms. They designate unobservable things, properties, or relations. Examples: "molecule," "atom," "electron."

## Carnap's assumptions

- 1 Sentences containing only logical and O-terms are about observable things. They can be tested directly by observation.
- 2 Sentences containing T-terms refer to unobservable things. They can't be tested directly by observation.

## Carnap's assumptions are wrong

- ① Sentences containing only logical and O-terms can be about unobservable things and not directly testable by observation. Example:
  - “Bodies are composed of hard unchanging parts that are too small to see” (Democritus's atomic theory).
- ② Sentences containing T-terms may be directly testable by observation after the theory is accepted. Examples:
  - “This bottle contains H<sub>2</sub>O.”
  - “There is an electron microscope in the next room.”

## Lewis's definitions (428)

- A  $T$ -term is “a theoretical term introduced by a given theory  $T$  at a given stage in the history of science.”
- An  $O$ -term is “any *other* term, one of our *original* terms, an *old* term we understood before the new theory  $T$  with its  $T$ -terms was proposed . . . Any old term can be an  $O$ -term, provided we have somehow come to understand it.”

## Example (not in Lewis)

- If  $T$  is the atomic theory of matter, then “atom” would be a  $T$ -term.
- If  $T$  is the theory that the atom has a nucleus composed of protons and neutrons, then “atom” may be an  $O$ -term and “proton” and “neutron” may be  $T$  terms.

## Definition (430, simplified)

Suppose theory  $T$  has  $T$ -terms  $\tau_1, \dots, \tau_n$ . Lewis writes  $T$  as:

$$\top[\tau_1 \dots \tau_n]$$

A *realization* of  $T$  is an ordered set of  $n$  entities:

$$\langle \text{entity}_1, \dots, \text{entity}_n \rangle$$

such that  $\top[\tau_1 \dots \tau_n]$  would be true if  $\tau_i$  designated  $\text{entity}_i$ , for  $i = 1, \dots, n$ .

## Example with one $T$ -term (not in Lewis)

Let  $T$  be Newton's second law of motion:

$$\text{force} = \text{mass} \times \text{acceleration}$$

Suppose "force" and "acceleration" are O-terms but "mass" is a T-term. Then  $T$  is written as:

$$\top[\text{mass}].$$

A realization of this (assuming the law is correct) is:

< the property of mass >

This is *not* a realization of it:

< the property of weight >

### Example with two $T$ -terms (not in Lewis)

Let  $T$  be a theory of the atomic nucleus in which the  $T$ -terms are “proton” and “neutron.” Then  $T$  can be written as:

$$\top[\text{proton, neutron}]$$

A realization of this (assuming the theory is correct) is:

< the property of being a proton, the property of being a neutron >

This is *not* a realization of it:

< the property of being a neutron, the property of being a proton >

- The Ramsey sentence of  $T$  is:

$$\exists x_1 \dots x_n \top [x_1 \dots x_n]$$

It says that  $T$  has a realization.

- The Carnap sentence of  $T$  is:

$$\exists x_1 \dots x_n \top [x_1 \dots x_n] \supset \top [\tau_1 \dots \tau_n]$$

It says that if  $T$  has a realization then  $T$  is true.

## Carnap's proposal (431)

*Carnap proposes to take the Ramsey sentence as the synthetic postulate of T and the Carnap sentence as the analytic postulate of T. They divide the labor of the original postulate, which both systematized O-sentences and partially interpreted the T-sentences. (Here and henceforth, when I speak of Carnap's proposal it should be understood that I mean Carnap's proposal minus Carnap's stipulation that the O-terms belong to an observation language.)*

# Questions

- 1 Carnap thought the language of science can be divided into two parts: (1) An observation language, which contains only logical and observation terms, and whose sentences can be tested directly by observation. (2) A theoretical language, whose sentences contain theoretical terms and can't be tested directly by observation. Is this correct? Justify your answer.
- 2 What does Lewis mean by a " $T$ -term" and an " $O$ -term"?
- 3 How does Lewis write a theory  $T$  so as to show its  $T$ -terms? What is a realization of  $T$ ?
- 4 Use the concept of a realization to explain in English what the Ramsey and Carnap sentences of a theory  $T$  say.
- 5 Let  $T$  be the "theory" that all electrons have the same electric charge. Suppose "electron" is a  $T$ -term and "electric charge" is an  $O$ -term. Describe (a) two different realizations of  $T$  and (b) something that isn't a realization of  $T$  (according to currently accepted science).



David Lewis.

How to define theoretical terms.

*Journal of Philosophy*, 67:427–446, 1970.

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Numbers in parentheses are page numbers of this article.

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