

# **SEMANTICS OF THOUGHT EXPERIMENTS**

CQU Chongqing CQ/CN 2013

VUB Brussels BE/EU 2015

## **WORLD LOGIC DAY 2021**

**DÍA MUNDIAL DE LA LÓGICA 2021**

**Sociedad Peruana de Epistemología y Lógica**

**Saturday January 16, 2021**

9:00–9:30 (PE) 14:00–14:30 (GMT)

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## IM Victims COVID-19

### Noam Chomsky on Mission Statement of *Earth Strike*

The Mission Statement of the Earth Strike is bold, ambitious and cogent. More than that, it issues a challenge that is of extreme urgency, addressing the most crucial question humans have ever had to face: do we have the will and the honor to act now to preserve the possibility of a decent existence for future generations, or are we so self-centered and cowardly that we will impose upon them a bitter fate - and not in the distant future.

### Let's say, retaking *Russell-Einstein Manifesto* (1955)

Their aim was a global general strike lasting from 20 until 27 September 2019. The movement has had public support from organizations including *Extinction Rebellion* and *Fridays for Future*, as well as public figures including Noam Chomsky.... The Earth Strikes were part of the worldwide September 2019 **climate strikes**, which gathered millions of protesters. (from *Wikipedia* italics and bold added)

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## **Abstract**

The research question of *Semantics of TE* for a unified but nonreductionist theory of TE is answered by a provisional proposal involving four views, *Extended Argument View* (TE Matrix, TE Diagram), *Extended Logic View* (incl. plausibility logic, possible worlds semantics PWS), *Descriptive Semantics View* and *Progress of Science and Society View* (incl. global cross-culturalism and environmental pragmatism).

TE are a quite common *methodology in philosophy and science*, but some philosophers and scientists are still skeptical or unsure about their use, e.g., because TE may involve imaginary premisses.

This research may show some manuals how to identify, analyze and interpret TE, e.g., how to transform TE into valid and sound arguments as with help of mathematical logic, e.g., (first order) predicate logic.

This presentation may focus on

- a- **Three Transformation Rules (TR) / Substitution Theses (ST)**  
**for the skeptics**
- b- **Descriptive Semantics View**
- c- **Iconic TE (Natural Sciences – Galileo, Einstein)**

## **Keywords**

semantics, thought experiment (TE), (non)classical logic, possible worlds semantics (PWS), (extended) argument view, (extended) logic view, descriptive semantics, progress of science and society  
James Brown, Noam Chomsky, Albert Einstein, Tamar Gendler, Tamara Horowitz, Saul Kripke, Ronald Laymon, Gerald Massey, John Norton, Karl Popper, Nicholas Rescher, Roy Sorensen, Ludwig Wittgenstein

## Examples of TE

The semantic TE theory is successfully applied to over ten examples of TE from mathematics, philosophy of mind (consciousness studies) and philosophy of natural sciences (classical and relativity physics).

Examples of TE (analyses) discussed in thesis and supplementary papers are, e.g., Aristotle's *Surface of a Sphere*, Euler's *0,9999 Equals 1*, Descartes's *Cogito*, Putnam's *Twin Earth*, Nagel's *What Is It Like to Be a Bat*, Kirk's and Chalmers's *Zombies*, Galileo's *Falling Bodies, Ship*, Einstein's *Magnet and Conductor, Elevator, Chasing a Beam of Light*, Martin Luther King Jr.'s *I Have a Dream*, Nelson Goodman's *Grue*, Quine's *Gavagai*, Ibn Sina's *Flying Man*, Gautama's *Vipassana Meditation*, Zhuangzi's *Butterfly Dream, Happiness of Fish, Liar* (Eubulides, Epimenides, Tarski – **forthcoming**), *Huatous/Koans* (Zhaozhou, Ekaku - **forthcoming**)

## **Four-fold Definition**

We assume a fourfold philosophical definition of TE.

*Ontologically speaking*, TE are mental phenomena;

*hermeneutically speaking*, TE are TE texts;

*logically speaking*, TE are incomplete arguments or enthymemes;

*on pragmaticist definition* TE are cognitive mental tests (i.e. tests that are executed in the mind) that are designed to resolve predefined problems

(see Hertogh 2015a, 2018, 252)

## 1- Skeptics

For the skeptics there are proposed Transformation Rules or Substitution Theses to substitute TE by experiments (TR/ST1) and nonmodal arguments (TR/ST2).

### Three Transformation Rules (TR) / Substitution Theses (ST)

TR1 / ST1--

**In the natural sciences TE can often be replaced by E** if not now (at the time of emergence of TE) than probably in near future (soon after conception of TE).

(This thesis is in accordance with e.g. Quine's philosophical gradualism).

E.g.

Galileo's *Falling Bodies* Gravity TE;

Einstein's *Magnet and Conductor* TE.

Einstein's *Bending a Ray of Light/Elevator* TE – Solar Eclipse E

Descartes's *Cogito ...* and Galileo's *Ship ...* obviously refer to daily experiences and these TE can be easily reenacted and checked by the reader; these TE belong both to Experience TE (TE<sub>EI</sub>) instead of category of Experiment TE (TE<sub>EX</sub>). This type of TE can be substituted by the everyday experiences the TE are recalling.



**Modal TE can very often be substituted by nonmodal alternates as in accordance with intention of TE-er/purport of TE text** e.g. when a TE-er first mentions some real examples and next proposes a modal version as to generalize, as because of an explanatory or logical gap, as because of disagreement--lack of consensus--on exact scientific make-up of real examples, as to complement, sustain and extend the nonmodal TE etc.

E.g.

Anselm's nonmodal *Ontological Argument* TE

Putnam's nonmodal *Elm/Beech* TE (preceding *Twin Earth*)

Nagel's visually and/or hearing impaired people (from birth), other minds (prec. *Bat*)

Kirk's sleeptalkers, sleepwalkers (preceding *Zombie*)

Chalmers's inverted spectrum (color blindness) as natural analogue of *Inverted Qualia*

TR3 / ST3--

**In modal TE and TE from humanities involving nonquantifiable and/or modal entities we can substitute the TE by a formal logical argument as by TE Matrix procedure.**

E.g.

Descartes's *Cogito* TE (hidden major—Whatever thinks, exists)

Gautama's *Vipassana Meditation* (hidden major - $Sx \rightarrow Mx$ )

Anselm's modal complement *OA* TE (God cannot be conceived not to exist)

Putnam's modal and sci-fi *Twin Earth* (consisting of many sub-TE e.g.  $H_2O/XYZ$ )

Nagel's *Bat* personification and Martian (e.g. inductive analogy)

Kirk's metaphysical possibility of *Zombies* ( $Cx \rightarrow Px, Cz, so, Pz$ )

Chalmers's *Zombie World* (*AMMA* – Anti-Materialist Modal Argument)



Suppose

[2']

$\forall x$  universal quantifier  
→ if ..., then ...

(0')  $\forall x (Tx \rightarrow Ex)$  whatever thinks, exists (for all x: if x thinks, then x exists)

(1') Ta a thinks, e.g., I think, Descartes thinks

----- TE inference

(2') Ea a exists, e.g., I exist/am, Descartes exists/is

Suppose

[2'']

$\exists x$  existential quantifier

(0'')  $\forall x (Tx \rightarrow Ex)$  whoever thinks, exists

(1'')  $\exists x Tx$  there is/are at least one/some human(s) who think(s)

----- TE inference

(2'')  $\exists x Ex$  there is/are at least one/some human(s) who exist(s)

(Please, see Hertogh 2016)

## 2.2- Analogous example—Gautama's *Vipassana Meditation*

[1]

Suppose

Mx x wants to attain Mindfulness, understanding, concentration

Sx x seeks Sense impressions

- negation

→ (material) implication, if ... then ...

then

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-Sa			
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Ma			

[2]

- Sx → Mx

- Sa

-----

Ma

(Please, see Hertogh 2018)

### 3- Extended Logic View

The Extended Argument View embraces *Extended Logic View* including nonclassical logics as *plausibility logic* and *PWS*.

We can hold on to *principle of bivalence*, for plausibility logic is a cognitive apparatus, and PWS involves theoretical possible worlds as available and accessible constituents of theories in mathematics and empirical sciences, which satisfy premises and conclusions of TE arguments unto positive truth values (T) on a bivalent logic.

Rescher's plausibilistic inference applied to plausibility logic of *P* (plausibility values) on horizontal line of **TE Diagram**, e.g., scale from 0 to 1 (0.0, 0.2, 0.4, 0.6, 0.8, 1.0).

Although **TE Matrix** logic is often reducible to classical logic, there are modal TE as well, e.g. in consciousness studies, philosophy of religion.

TE Matrix shows how TE hook upon the **external world**.

TE Diagram shows how TE hook upon the **human mind** (that is, on the minds of a particular group of participants to the survey).

#### 4- Descriptive Semantics View

As the PW of TE arguments (premises and conclusions) pick out accessible possible worlds (as from axioms to principles) unto the argument is both formally and informally logically validated (ie logical inference is valid, premises and conclusions are true—so, argument is sound), we don't need to *prescribe* any (fixed) set of (possible) worlds, nor any forcing formal validation function nor any properties of possible accessibility relation, for the time being.

*(Descriptive Semantics View)*

#### 4.1- Applying e.g. Kripke's frame semantics ... triple $\langle W, |=, R \rangle$

Kripke's terminology changes with development of his model theory; these days one speaks of a triple  $\langle W, |=, R \rangle$ ,

$W$  set of possible worlds  $w$ , among which  $w_0$  the actual world,  $|=$  validation or valuation function,  $R$  accessibility relation among possible worlds. There are discussions on, e.g., question if the set of possible worlds is fixed, finite or (seeming, near-, quasi-)infinite; there are alternate terminologies e.g. satisfaction relation instead of validation function; and one may debate properties of the accessibility relation as reflexivity, transitivity etc. (e.g. Kripke 1959, 1963a, 1963b, 1965) or don't posit any accessibility relation at all (e.g. Carnap 1956).  
(from Hertogh 2021 – forthcoming)

We propose some possible changes to available proposals of modal semantics and in next sections discuss usual elements of e.g. Kripke's frame semantics  $\langle W, R, |= \rangle$  on a descriptive (instead of prescriptive) semantic interpretation.

#### 4.2- Set of (P)W ( $w_0, w_1, w_2, w_3 \dots w_n$ )

When applying to thought experiments, we picture PW as (constituents of) theories, maxims, laws, regularities, axioms, theorems, principles, that may be found in context and theoretical background of TE concerned, or with help of search engines as Google, Google Scholar, Yahoo, Baidu etc.

We may answer question as with regard to (in)finity of set of PW, with reference to internet capacity or database of 'very large-scale search engines,' by quoting from Google founders Sergey Brin's and Lawrence Page's famous 1998 paper, 'The Anatomy of a Large-scale Hypertextual Web Search Engine', e.g.

.... Search engines index tens to hundreds of millions of web pages involving a comparable number of distinct terms. They answer tens of millions of queries every day....

....

Because humans can only type or speak a finite amount, and as computers continue improving, text indexing will scale even better than it does now. *Of course there could be an infinite amount of machine generated content, but just indexing huge amounts of human generated content seems tremendously useful....*

(Brin, Page 1998 – italics added)

Using TE may resemble thinking when 'thinking is like googling' (e.g. Miłkowski 2019 referring to Newell and Simon 1972).



### 4.3- Accessibility Relation (e.g. $w_1Rw_2$ )

We don't think it is necessary to define properties of accessibility relation R (like reflexivity, transitivity etc.\*--see Kripke 1959, 1963a, 1963b, 1965, Rehder 1980 ) as it may limit the range of internet searches. There are modal logicians who don't posit any accessibility relation R at all, e.g., Carnap 1956--although we can't agree on more aspects of Carnap's modal logic, possible world ('state-description') semantics, as a given set of fixed PW, which may be considered part of prescriptive semantics, which we exactly want to avoid in our descriptive semantics.

We may do by adding accessibility relation R but leaving it unspecified as with regard to (mathematical) properties, instantiation of laws, rules, principles etc. for the time being.

\*reflexivity  $w_1Rw_2 = w_2Rw_1$

transitivity  $w_1Rw_2 \wedge w_2Rw_3 \rightarrow w_1Rw_3$

#### 4.4- Satisfiability Relation (e.g. $w \models \varphi$ )

A validation function or satisfiability relation connects a (set of) statement(s) to a (set of) possible world(s), saying if statement is true or false in PW concerned.

E.g. generally speaking

[1]

$w \models \varphi$                       for  $w$  it holds that  $\varphi$   
or e.g.  $\varphi$  is true, exists in  $w$

These relations don't need to be prescribed, and, in fact, *cannot* be defined beforehand as e.g. set of PW is not fixed and given in advance.

Signs and notation may differ--

e.g.  $\Phi, \Vdash, V$ (aluation)

e.g. Kripke 1963 : 69-70

... we are given an arbitrary set  $K$  of 'possible worlds', a distinguished 'real world'  $G$ , and a function  $\Phi(P, H)$  assigning to each proposition  $P$  a truth-value in the world  $H$ ...

e.g. Goranko, Valentin, and Martin Otto 2006

.... A *Kripke structure (Kripke model)* ...

where  $V : \Phi \rightarrow P(W)$  is a *valuation*, assigning to every atomic proposition  $p$  the set of states in  $W$  where  $p$  is declared true.

## 5- Progress of Science and Society View

On *Progress of Science and Society View* a *fallible* theory (as after Karl Popper, Imre Lakatos) is proposed (including error correction in the heuristic process of picking out available and accessible PW) that defines TE as *cognitive mental tests* designed to *resolve (predefined) problems*.

Subtheses of *global cross-culturalism* and *environmental pragmatism* criticize and substitute cultural, economic, moral and scientific *biases* of bygone era of modernism.

We can summarize these maxims in an addition to Karl Popper's formula on growth of knowledge, progress of science ('...fundamental evolutionary sequence of events...  $P_1 \rightarrow TS \rightarrow EE \rightarrow P_2$ ' - Popper 1979, 243), modifying it into progress of science and society

$$\mathbf{P_1 \rightarrow TS \rightarrow EE/EP GC \rightarrow P_2}$$

where *P* stands for Problem, *TS* for Tentative Solutions, *EE* for Error Elimination; *EP* for Environmental Pragmatism and *GC* for Global Cross-culturalism. The forward slash at EE wants to allow for 21st-century global cross-cultural and environmental criticisms (as to save Planet Earth ...).

(Hertogh 2018, 270n9 – bold added)

**GCC** – next to established, legal developments as antidiscrimination, antisexism, antiracism, migration e.g. global digital village, from MLK to BLM, corona Zoom meetings

**EEP** – next to established, legal developments as CO2 reduction, electrical vehicles, e.g. climate action, Greta Thunberg, Fridays For Future, Extinction Rebellion, Earth Strike, Noam Chomsky

e.g. ... [W]e ... draw attention to the *Russell-Einstein Manifesto* (1955) which was conceived as comment on the first use of nuclear weapons in history, the A-bombing of Hiroshima and Nagasaki on August 6 and 9, 1945, by USA--

We are speaking on this occasion, not as members of this or that nation, continent, or creed, but as human beings, members of the species Man, whose continued existence is in doubt. ....

As a result of the manifesto and many conferences of celebrated fundamental scientists there came about ***Nuclear-Weapons-Free Zones***, in total, seven treaties, particularly among countries of the Southern Hemisphere.

In conclusion, it seems a couple of the historical blunders of western science, colonialism and imperialism are being corrected though there are too many setbacks to enumerate in a single dissertation. If the Northern Hemisphere keeps on engaged in unnecessary, unecological and uneconomic nuclear arm races, we can only keep our hopes up high for a more decent and ecological development of the Southern Hemisphere which renders our discussion of Martin Luther King Jr.'s Africana philosophy even more relevant than one could have expected in 1963.

(from Hertogh 2015)

## 6- TE Diagram

We may try and conduct a TE survey but if number of participants ( $n$ ) is less than 50, *MOE* (margin of error) is too large to have significant, statistically reliable results.

We may refer to forthcoming contribution to Integrated Science series for an example of a successful survey, conducted at Chongqing University in 2013, on a couple of Chinese, Daoist TE, where  $n > 50$ .

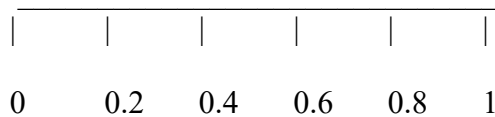
**TE Diagram** (survey to CP Hertogh 'Semantics of Thought Experiments')

**TE Diagram UNESCO World Logic Day 2021** (FernUni Hagen Jan. 14, 17:15-17:45 CET)

Please, complete diagram after the presentation (by  $V$  (✓) with help of PDF comments as sticky notes) by indicating plausibility value ( $P$ ) of thought experiments (TE) in below diagram on a six-point scale from '0' (bizarre, very unlikely, very implausible to be logically true, valid, sound) through '1' (obvious, very likely, very plausible to be logically true, valid, sound) by marking the appropriate diagram points. If you cannot attend the talk, still try to complete the diagram, but check here ..... NOT ATTENDED. Please, indicate your gender (M/F/X), position (Student/Researcher/Etc.), nationality/etc. (.....). Kindly return completed TE Diagram to [noromyxo2005@gmail.com](mailto:noromyxo2005@gmail.com), [noromyxo2000@yahoo.com](mailto:noromyxo2000@yahoo.com)

THOUGHT  
EXPERIMENT (TE)

<b>Pythagorean Theorem</b> (e.g.) $a^2 + b^2 = c^2$	.	.	.	.	.	.
<b>Descartes's Cogito</b> (e.g.) $\forall x (Tx \rightarrow Ex)$	.	.	.	.	.	.
<b>Putnam's Twin Earth</b> (e.g.) $H_2O/XYZ$	.	.	.	.	.	.
<b>Anselm's Ontological Argument</b> (e.g.) $Eg > Cg$	.	.	.	.	.	.
<b>Galileo's Falling Bodies</b> (e.g.) $\forall x (Fx \rightarrow Sx)$	.	.	.	.	.	.
<b>Einstein's Chasing a Beam of Light</b> (e.g.) $(F_{inc} \vee F_{ex}) \leftrightarrow L$	.	.	.	.	.	.
<b>Buddha's Insight Meditation</b> (e.g.) $\forall x (-Sx \rightarrow Mx)$	.	.	.	.	.	.



PLAUSIBILITY VALUE ( $P$ )

**Thank you**

**谢谢**

*Are there any questions?*

**CP Hertogh**

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