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Linguistic solution to the mind-body problem

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Abstract

Recently we proposed "quantum language", which was not only characterized as the metaphysical and linguistic turn of quantum mechanics but also the linguistic turn of Descartes=Kant epistemology. If this turn is regarded as progress in the history of Western philosophy, we should study the linguistic mind-body problem more than the epistemological mind-body problem. In this preprint we show that quantum language solves the final solution to the mind-body problem, that is, our linguistic solution is the only true solution in philosophy (i.e., dualistic idealism).

Key phrases: History of Western Philosophy, Quantum Language, Progress, Mind-body Problem, Linguistic Copenhagen interpretation,

1 Review: Quantum language (= Measurement theory);

If readers are not familiar with quantum theory, it may be recommended to skip this section and start reading from Section 2.
Following refs. [3, 4, 5, 8], we shall review quantum language (i.e., the linguistic Copenhagen interpretation of quantum mechanics, or measurement theory), which has the following form:

$$\underset{\text{(= measurement theory)}}{\boxed{\boxed{\text{Quantum langage}}}} = \underset{\text{(Axiom 1)}}{\boxed{\text{measurement}}} + \underset{\text{(Axiom 2)}}{\boxed{\text{causality}}} + \underset{\text{(how to use Axioms 1 and 2)}}{\boxed{\text{linguistic (Copenhagen) interpretation}}} \tag{1}$$

I believe that quantum language is the only successful dualistic idealism (where idealism=metaphysics).

1.1 Mathematical Preparations

Consider an operator algebra $B(H)$ (i.e., an operator algebra composed of all bounded linear operators on a Hilbert space H with the norm $\|F\|_{B(H)} = \sup_{\|u\|_H=1} \|Fu\|_H$). Let $\mathcal{A}(\subseteq B(H))$ be a C^*-algebra, which is assumed to have the identity I. Let $\mathcal{A}^*$ be the dual Banach space of $\mathcal{A}$. That is, $\mathcal{A}^* = \{\rho \mid \rho$ is a continuous linear functional on $\mathcal{A}$ $\}$, and the norm $\|\rho\|_{\mathcal{A}^*}$ is defined by $\sup\{|\rho(F)| \mid F \in \mathcal{A}$ such that $\|F\|_{\mathcal{A}}(= \|F\|_{B(H)}) \le 1\}$. Define the *mixed state* ρ $(\in \mathcal{A}^*)$ such that $\|\rho\|_{\mathcal{A}^*} = 1$ and $\rho(F) \ge 0$ for all $F \in \mathcal{A}$ such that $F \ge 0$. And define the mixed state space $\mathfrak{S}^m(\mathcal{A}^*)$ such that

$$\mathfrak{S}^m(\mathcal{A}^*) = \{\rho \in \mathcal{A}^* \mid \rho \text{ is a mixed state}\}.$$

A mixed state $\rho(\in \mathfrak{S}^m(\mathcal{A}^*))$ is called a *pure state* if it satisfies that "$\rho = \theta\rho_1 + (1-\theta)\rho_2$ for some $\rho_1, \rho_2 \in \mathfrak{S}^m(\mathcal{A}^*)$ and $0 < \theta < 1$" implies "$\rho = \rho_1 = \rho_2$". Put

$$\mathfrak{S}^p(\mathcal{A}^*) = \{\rho \in \mathfrak{S}^m(\mathcal{A}^*) \mid \rho \text{ is a pure state}\},$$

which is called a *state space.*

An *observable* $\mathsf{O} := (X, \mathcal{F}, F)$ in $\mathcal{A}$ (or, a *measuring instument* $\mathsf{O} := (X, \mathcal{F}, F)$ in $\mathcal{A}$) is defined as follows:

(i) [field] X is a set, $\mathcal{F}(\subseteq 2^X$, the power set of $X)$ is a field of X, that is, "$\Xi_1, \Xi_2 \in \mathcal{F} \Rightarrow \Xi_1 \cup \Xi_2 \in \mathcal{F}$", "$\Xi \in \mathcal{F} \Rightarrow X \setminus \Xi \in \mathcal{F}$", "$\emptyset \in \mathcal{F}$".

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(ii) [additivity] F is a mapping from $\mathcal{F}$ to $\mathcal{A}$ satisfying: (a): for every $\Xi \in \mathcal{F}$, $F(\Xi)$ is a non-negative element in $\mathcal{A}$ such that $0 \leq F(\Xi) \leq I$, (b): $F(\emptyset) = 0$ and $F(X) = I$, where 0 and I is the 0-element and the identity in $\mathcal{A}$ respectively. (c): for any $\Xi_1, \Xi_2 (\in \mathcal{F})$, it holds that $F(\Xi_1 \cup \Xi_2) = F(\Xi_1) + F(\Xi_2) - F(\Xi_1 \cap \Xi_2)$ in $\mathcal{A}$.

1.2 Axiom 1 [Measurement] and Axiom 2 [Causality] in Quantum Language

Quantum language (1) is composed of two axioms (i.e., Axioms 1 and 2) as follows. With any *system* S, a C^*-algebra $\mathcal{A}(\subseteq B(H))$ can be associated in which the measurement theory (1) of that system can be formulated. A *state* of the system S is represented by an element $\rho(\in \mathfrak{S}^p(\mathcal{A}^*))$ and an *observable* is represented by an observable $\mathsf{O} := (X, \mathcal{F}, F)$ in $\mathcal{A}$. Also, the *measurement of the observable* O *for the system* S *with the state* ρ (or *the measurement for the system* S *with the state* ρ *by the measuring instrument* O) is denoted by $\mathsf{M}_{\mathcal{A}}(\mathsf{O}, S_{[\rho]})$ $\big($ or more precisely, $\mathsf{M}_{\mathcal{A}}(\mathsf{O} := (X, \mathcal{F}, F),\ S_{[\rho]})$ $\big)$. An observer can obtain a measured value x $(\in X)$ by the measurement $\mathsf{M}_{\mathcal{A}}(\mathsf{O}, S_{[\rho]})$.

The Axiom 1 presented below is a kind of mathematical generalization of Born's probabilistic interpretation of quantum mechanics. And thus, it is a statement without reality.

Now we can present Axiom 1 in the C^*-algebraic formulation as follows.

Axiom 1 [Measurement]. *The probability that a measured value x $(\in X)$ obtained by the measurement* $\mathsf{M}_{\mathcal{N}}(\mathsf{O} := (X, \mathcal{F}, F),\ S_{[\rho]})$ (*i.e., measurement of the observable* O *for the system* S *with the state* ρ, or *measurement for the system* S *with the state* ρ *by the measuring instrument* O) *belongs to a set* $\Xi(\in \mathcal{F})$ *is given by* $\rho(F(\Xi))$.

Next, we explain Axiom 2. Let $\mathcal{A}_1(\subseteq B(H_1))$ and $\mathcal{A}_2(\subseteq B(H_2))$ be C^*-algebras. A continuous linear operator $\Phi_{1,2} : \mathcal{A}_2 \to \mathcal{A}_1$ is called a *Markov operator,* if it satisfies that (i): $\Phi_{1,2}(F_2) \geq 0$ for any non-negative element F_2 in $\mathcal{A}_2$, (ii): $\Phi_{1,2}(I_2) = I_1$, where I_k is the identity in $\mathcal{A}_k$, $(k = 1, 2)$.

It is clear that the dual operator $\Phi_{1,2}^* : \mathcal{A}_1^* \to \mathcal{A}_2^*$ satisfies that $\Phi_{1,2}^*(\mathfrak{S}^m(\mathcal{A}_1^*)) \subseteq \mathfrak{S}^m(\mathcal{A}_2^*)$. If it holds that $\Phi_{1,2}^*(\mathfrak{S}^p(\mathcal{A}_1^*)) \subseteq \mathfrak{S}^p(\mathcal{A}_2^*)$, the $\Phi_{1,2}$ is said to be deterministic. If it is not deterministic, it is said to be non-deterministic. Also note that, for any observable $\mathsf{O}_2 := (X, \mathcal{F}, F_2)$ in $\mathcal{A}_2$, the $(X, \mathcal{F}, \Phi_{1,2} F_2)$ is an observable in $\mathcal{A}_1$.

Now Axiom 2 is presented as follows. (For details, see ref. [8].)

Axiom 2 [Causality]. *Let $t_1 \leq t_2$. The causality is represented by a Markov operator $\Phi_{t_1,t_2} : \mathcal{A}_{t_2} \to \mathcal{A}_{t_1}$.*

1.3 The linguistic interpretation (= the manual to use Axioms 1 and 2)

In the above, Axioms 1 and 2 are kinds of spells, (i.e., incantation, magic words, metaphysical statements), and thus, it is nonsense to verify them experimentally. Therefore, what we should do is not "to understand" but "to use". After learning Axioms 1 and 2 by rote, we have to improve how to use them through trial and error.

We can do well even if we do not know the linguistic interpretation (= the manual to use Axioms 1 and 2). However, it is better to know the linguistic interpretation , if we would like to make progress quantum language early. I believe that the linguistic interpretation is the true Copenhagen interpretation (*cf.* ref. [2]).

In Figure 1 (on Page 3), I remark:

(A_1) ⓧ: it suffices to understand that "interfere" is, for example, "apply light".
ⓨ: perceive the reaction.

That is, "measurement" is characterized as the interaction between "observer" and "measuring object (= matter)". However,

(A_2) in measurement theory (=quantum language), "interaction" must not be emphasized.

Therefore, in order to avoid confusion, it might better to omit the interaction "ⓧ and ⓨ" in Figure 1.

After all, we think that:

(A_3) it is clear that there is no measured value without observer (i.e., "I", "mind"). Thus, we consider that measurement theory is composed of three key-words:

$$\underset{\text{(I, observer, mind)}}{\boxed{\text{measured value}}}, \quad \underset{\text{(body(= sensory organ), thermometer, eye, ear, polar star}^2\text{)}}{\boxed{\text{observable (= measuring instrument)}}}, \quad \underset{\text{(matter)}}{\boxed{\text{state}}}, \tag{2}$$

The essence of the manual is as follows:

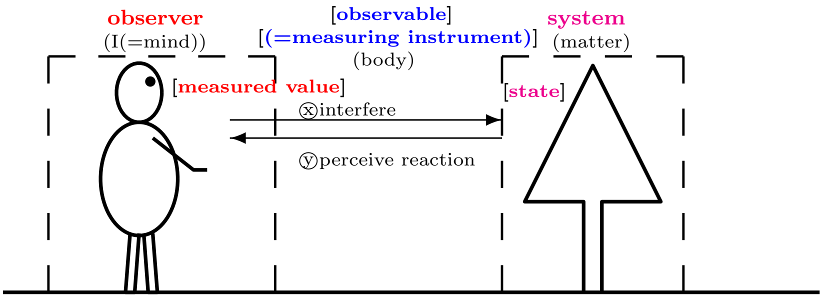

Figure 1: [Descartes Figure]: Image of "measurement(=ⓧ+ⓨ)" in mind-matter dualism

The linguistic interpretation says that

(B) **Only one measurement is permitted.** And thus, the state after a measurement is meaningless since it can not be measured any longer. Thus, the collapse of the wavefunction is prohibited. We are not concerned with anything after measurement. Strictly speaking, the phrase "*after the measurement*" should not be used. Also, the causality should be assumed only in the side of system, however, a state never moves. Thus, the Heisenberg picture should be adopted, and thus, the Schrödinger picture should be prohibited.

and so on. For details, see ref. [2, 8].

1.4 The history of world description

[The location of quantum language in the history of world-description (*cf.* refs.[5, 8])]

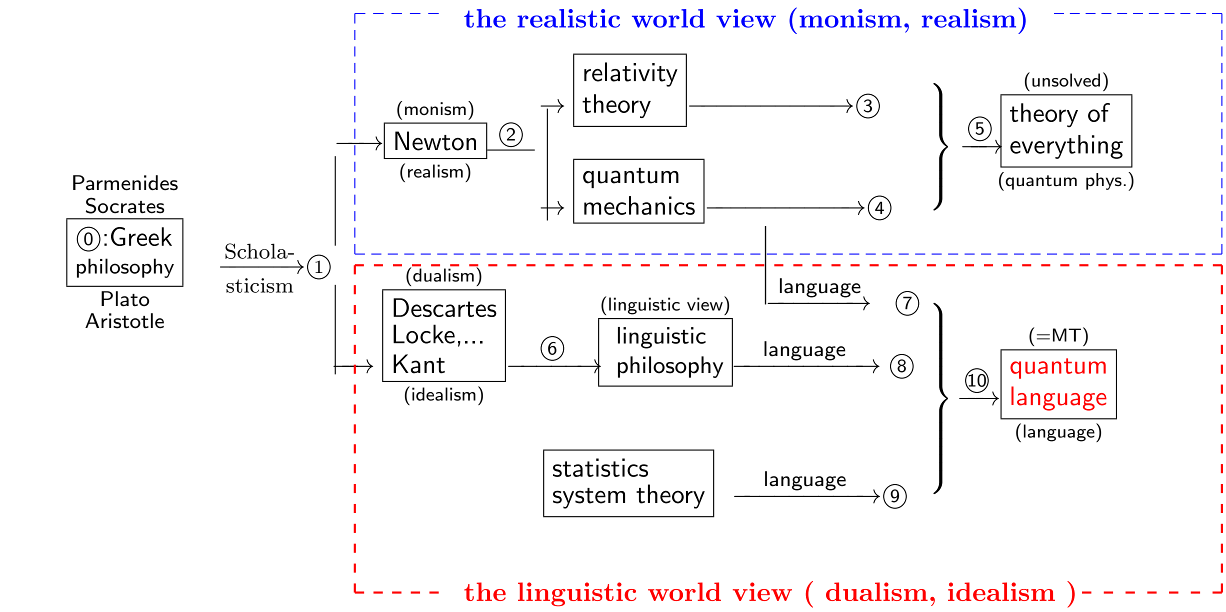

Figure 2: The history of the world-description

[2] if compass is a measuring instrument, the polar star is also so (*cf.* ref. [6]).

In the above figure, let us focus on the history of the dualistic idealism in the linguistic world view such as

$$\boxed{\text{Plato}} \longrightarrow \boxed{\text{Descartes}} \longrightarrow \boxed{\text{Locke}} \longrightarrow \boxed{\text{Kant}} \tag{3}$$

Note that physics obviously made progress in Figure 2, on the other hand, the (2)'s progress is not clear. In ref. [9], we asserted that, if "progress" is defined by "approaching quantum language", then

(C_1) the (2) does not imply time series but also progress, that is,

$$\boxed{\text{Plato}} \xrightarrow[\text{progress}]{} \boxed{\text{Descartes}} \xrightarrow[\text{progress}]{} \boxed{\text{Locke}} \xrightarrow[\text{progress}]{} \boxed{\text{Kant}} \xrightarrow[\text{progress}]{} \boxed{\text{Quantum language}} \tag{4}$$

(C_2) Quantum language is the only successful dualistic idealism

2 Three approaches to the mind-body problem

If quantum language is the only successful dualistic idealism, it is natural to study the mind-body problem in quantum language. This will be discussed in Section 2.4.

2.1 Mind-body problem

In spite that the cogito proposition "I think, therefore I am" is non-sense (*cf.* ref. [8, 9]), Descrtes used it in order to propose Descartes philosophy (i.e., mind-matter dualism). That is, he asserted

(D) If "I" is accepted, the existence of "matter" (which is perceived by "I") is accepted. And further, the medium of "I" and "matter" is automatically accepted as "body (= sensory organ)".

Therefore, the key-words of Descartes philosophy (= mind-matter dualism) is

(E) "I"(="mind"), "body"(="sensory organ"), "matter"

Here, we have the following problem, which is said to be the greatest unsolved problem in philosophy:

(F): mind-body problem:

How "mind" and "body" are connected?

(or more generally, How "mind", "body" and "matter" are connected?)

2.2 The first approach; Brain scientific approach

Although I think, from the philosophical point of view (as mentioned in [9]), that

(G) $\boxed{\text{Locke}} \xrightarrow[\text{regress}]{} \boxed{\text{Hume}}$ and $\boxed{\text{Kant}} \xrightarrow[\text{regress}]{} \boxed{\text{Husserl}}$

some may consider, from the scientific point of view, that

(H) $\boxed{\text{Locke}} \xrightarrow[\text{progress}]{} \boxed{\text{Hume}} \xrightarrow[\text{progress}]{} \boxed{\text{Philosophy of mind ($\supset$ brain science)}}$ and

$\boxed{\text{Kant}} \xrightarrow[\text{progress}]{} \boxed{\text{Husserl}} \xrightarrow[\text{progress}]{} \boxed{\text{Philosophy of mind ($\supset$ brain science)}}$

This (i.e., the contradiction of (G) and (H)) may be due to the confusion of philosophy and science. It should be noted that the direction of (H) implies the abandonment of dualistic idealism. Although I know the importance of the scientific aspect of the mind-body problem, I think that the mind-body problem (F) should be within philosophy (particularly, dualistic idealism). Hence, I am not concerned with the first approach (i.e., the study related to the (H)).

2.3 The second approach; Concerning Wittgenstein's famous saying "What we cannot speak about we must pass over in silence" cf. ref. [11]

It should be noted that

(I) the term "mind" and "body" in the mind-body problem (F) is ambiguous.

That is, the sentence "How 'mind' and 'body' are connected?" in (F) is ambiguous. Thus, there may be a reason to consider that the mind-body problem is just "what we cannot speak about". Therefore, we must speak nothing about the problem (F). However, I think, by (J) and (K) mentioned in the following section, that this second approach is not only non-productive but also wrong.

2.4 The third approach; Quantum linguistic solution to the mind-body problem

It should be noted that

(J) the demarcation problem (i.e., how to distinguish between "what we cannot speak about" and "what we can speak about") depends on language.

For example, the proposition "the earth goes around the sun" can not be written in mathematics but in the Newtonian mechanical language. Therefore,

(K) in order to solve the mind-body problem, we should create the language in which the mind-body problem can be regarded as "what we can speak about"

Without this challenge (K), we cannot obtain the solution to the mind-body problem. In this sense, the second approach in Section 2.3 may be shallow.

This (K) is done as follows. Recall the linguistic turn (*cf.* refs. [5, 8, 9]):

[Descartes= Kant epistemology] $\xrightarrow[\text{linguistic turn}]{}$ [Quantum language]

and recall Figure 1, in which we see the following correspondence:

(L) [mind] (brain, Descartes) $\xrightarrow[\text{progress}]{ⓐ}$ [measured value] (Quantum language), [body] (sensory organ, Descartes) $\xrightarrow[\text{progress}]{ⓑ}$ [observable] (measuring instrument, Quantum language), [matter] (Descartes) $\xrightarrow[\text{progress}]{ⓒ}$ [system] (Quantum language)

The ⓐ in (L) may be slightly incomprehensible. However, it suffices to consider "there is no measured value without brain". For example when a needle of a voltmeter just moved, it is only a physical phenomenon. Nevertheless a movement of this needle is read, and it's sensed by a brain. Then, it for the first time becomes "measured value".

Clearly, "eye" can be regarded as "measuring instrument". Conversely, glasses, microscope, telescope, etc. is a kind of body (= sensory organ). If so, we want to conclude the ⓑ in (L), that is,

$$\text{body (particularly, sensory organ)} \fallingdotseq \text{measuring instrument (= observable)}$$

Also, ⓒ is obvious.

Thus, we can, by (L), consider the linguistic turn of "the epistemological mind-body problem" to "the linguistic mind-body problem" such as

Descartes: [epistemological mind-body problem] (How are "mind" and "body" connected?) $\xrightarrow{\text{linguistic turn}}$ quantum language: [linguistic mind-body problem] (How are "measured value" and "observable" connected?)

Hence, it is easily solved by Axiom 1, that is,

(M): The linguistic solution to the mind-body problem:

Axiom 1 says that "measured value" and "observable ($\approx$ measuring instrument)" are connected as follows.

- *The probability that a measured value x $(\in X)$ obtained by the measurement $\mathsf{M}_{\mathcal{N}}(\mathsf{O} :=(X, \mathcal{F}, F), S_{[\rho]})$ (i.e., measurement of the observable O for the system S with the state ρ,* or *measurement for the system S with the state ρ by the measuring instrument O) belongs to a set $\Xi (\in \mathcal{F})$ is given by $\rho(F(\Xi))$.*

3 Conclusion

In refs. [8, 9], I asserted that the following three are equivalent:

(O_1) to propose quantum language

(O_2) to clarify the Copenhagen interpretation of quantum mechanics

(O_3) to clarify the final goal of the dualistic idealism

(O_4) to reconstruct statistics in the dualistic idealism

In this paper I assert that the mind-body problem should be reconsidered in quantum language. This was done in Section 2.4, and the the solution (M) was obtained. That is, I conclude that the following (O_5) is also equivalent to the above (O_i) ($i = 1, 2, 3, 4$):

(O_5) to solve the mind-body problem and the causal problem (i.e., to find Axiom 1 and Axiom 2)

That is, all of (O_i) ($i = 1, 2, 3, 4, 5$) are equivalent. If so, I can understand the reason why the mind-body problem is generally said to be the most important problem in the dualistic idealism.
I am convinced that my proposal is the final solution to the mind-body problem (i.e., the first approach in Section 2.2 is a misdirection, and the second approach is shallow). Hence, I hope that it will be examined from various points of view[3] .

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