A Formal Bi-Logic Framework for the Mental Processes

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Abstract

This paper addresses questions of the transition related to conscious processes and unconscious processes, namely aims to substantiating a primary framework to the following open question: The vast majority of brain activity is non-conscious. What is the criterion to distinguish the non-conscious activities from conscious ones? To support our answers in a principled way, we present a general framework for the study of mental processes resting on two main principles: firstly, we endorse Matte Blanco's principle of symmetry by giving central stage to the concept of unconscious processes. Secondly, to structure and combine the notions of infinity and part-whole equivalence in a mathematical logic method, moreover we base our work on modern non-classical logics in the disposition of context-dependency, as forcefully put forward by CJS Clarke. In particular, we employ the paraconsistent logic as the underlying logical system for defining the general framework for mental processes, highly structural and formal representation, called bi-logic framework.

Introduction

The open question: (i) The vast majority of brain activity is non-conscious. What is the criterion to distinguish the non-conscious activity from consciousness ones? Traditionally, investigations about this question are at least based on the four methodologies as follows:

- physiology and neuroscience version
- theoretical physics version
- psychoanalysis version
- logical/informative version

The combination of the psychoanalysis version with the logical/information version is what we would like to propose to deal with this question. *Bi-logic* can be thought of as establishing common agreements among Freud's idea of unconscious processes on the logical meaning of psychoanalysis terms in a particular field. It turns out that a certain sense of psychologism are proposed with this rather young field will support the interdisciplinary perspective as we suggested by the tile of this paper. Just as in the fields of philosophical logic (or non-classical logic), bi-logic directs a potential of formal logic with psychoanalysis towards a new branch of non-classical logic. We here explore its various roles in psychoanalysis and modern non-classical logic, the "reasoning" it supports.

More specifically, this paper is about the foundations of the structuralist logic of mind in psychoanalysis. It is not, however, about 'best practices' not does it discuss specific approaches to or methodologies for various computation models and the cognitive architecture. Rather, we outline a general methodological and theoretical environment for the understanding and construction of formal rules, and the difficult of corresponding logics that could be chosen. This framework rests, on a very general level, on two main principles: firstly, we endorse Matte Blanco's principle of symmetry by giving central stage to the concept of unconscious processes. Secondly, to structure and combine the notions of infinity and part-whole equivalence in mathematical logic method, we base our work on modern non-classical logics in the disposition of context-dependency, as forcefully put forward by CJS Clarke.

Amongst the many modern discussions about Sigmund Freud's relative proposals of unconscious processes as either a psychoanalytic, clinical psychological discipline or a philosophical discipline (Macintyre 2004), we present an opinion given by Stuart Hameroff (Hameroff 2007) as the **Freudian Renaissance** because of its clarity and brevity with his interdisciplinary disposition:

> "[...] Sigmund Freud saw dreams as the "royal road to the unconscious" whose bizarre character was due to censorship and disguise of thwarted drives. Freud's ideas became downplayed, and dreams characterized as mental static [...] However, recent brain imaging shows dream-associated REM sleep activity in regions associated with emotion and gratification [...]"

The notion of Freudian Renaissance after the 1970s as a psychoanalysis artefact, on the one hand, grew out of a trend of mathematical logic lies at heart of modern knowledge in computer science and artificial intelligence, namely Matte Blanco's *unconscious as an infinite set* proposal (MBT, thereafter) (Blanco 1975).

In literature, MBT deals with unconscious processes with regard to mathematical logic, especially to combine the phenomena discussed in the psychoanalysis with basic notions

used in the mathematical logic to study the unconscious processes, of which the emotions play the key role (Blanco 1988) (Rayner 1995). Although classical reasoning is still predominant in current trend of various practices in computer science, it has been realized in recent years that there are many different application stories by means of monclassical reasoning, for example, default and non-monotonic reasoning, paraconsistent reasoning, or various uncertain reasoning, and quantum reasoning. In the same way, some relative developments in this trend about non-classical logics could have been studied to the proposal of MBT.

Quantum logic, for instance, is important in the comparison with bi-logic, in particular when both of them could be seen as a sort of context-dependent logic based on a sheaf-theoretic framework (Clarke 2006). Paraconsistent logic as another instance is quite important in this paper, in particular when reviewing the characteristics in unconscious processes formulated by Freud, it is easily derived that the logic for the continuum of conscious and unconscious processes (or symmetrical-continuum) would be paraconsistent, i.e. to tolerate inconsistency without following anything, knowm as *ex contradictione sequitur quodlibet* (Fu 2012).

From MBT to Paraconsistent Framework

Like what philosopher Ludwig Wittgenstein has done in his *Tractatus Logico-Philosophicus*, MBT treats "logic" as a certain of formal method to analyze the psycho-analytical concepts. The individual's experiences of infinity and the *part=whole* equivalence in the unconscious processes make MBT formulate these two principles as follows: (Blanco 1975)

(i) **Principle of generalization** The system of unconscious treats an individual thing (person, object, concept) as if it were a member or element of a set or class which contains other members; it treats this set or class as a subclass of a more general class, and this more general class as a subclass or subset of a still more general class, and so on.

(ii) **Principle of symmetry** The system of unconscious treats the converse of any relation as identical with the relation. In other words, it treats asymmetrical relations as if they were symmetrical.

It is straightforward that consequently a subclass may be identical with any other subclass of the same class (Blanco 1975) (Blanco 1988) (Rayner 1995).

As described by psychoanalyst, Eric Rayner that the discrimination of difference is crucial to human life that requires the awareness of asymmetry to distinguish that some things are not interchangeable with each other. Moreover, it is also crucial to identify some things essentially the same as another things, namely to have the registration of sameness (Rayner 1995).

The study of these principles can be carried out to a quite large extent independently of the details of the underlying logic translation processes that is widespread in theoretical computer science and ontology designs (Kutz et al. 2010) (Mossakowski et al. 2009) (Mossakowski et al. 2007). Adopting the structuralist position that MBT has taken, we explore the potential transition within bi-logic framework. Recall that it is straightforward that in the continuum of conscious and unconscious processes should be paraconsistent, since the observable phenomena in unconscious processes: *the absence of mutual contradiction and negation* and *the co-presence of contradiction* (Fu 2012). Thus, it is nature to specify any paraconsistent logic as the underlying logics of the conscious processes and unconscious processes, respectively.

The Difficulties in the Bi-logic Transition Processes

We assume some acquaintance with the basic notion of paraconsistent logic and refer to (Béziau 2006) (Béziau 2000) (Priest 2000) for an introduction. Here we do not discuss whether to accept inconsistency but instead to articulate the paraconsistency in the bi-logic framework. The rejection of principle of explosion is sufficient to characterize the paraconsistency via either formulating a paraconsistent consequence relation or a paraconsistent negation. Here, the most immediate difficulties to bi-logic framework intuitively is perhaps given when classical logic and paraconsistent logic are thought of as the underlying logics of conscious processes and unconscious processes, respectively in terms of the mechanism of combing logics.

The styles of combining logics (Gabbay 1999) have already been widely discussed, among which *the paradox of combination* are raised further (Béziau and Coniglio 2005) (Béziau 2004) . Here in particular in the combination of *logic of conscious processes* (**LMCon**) and *logic of unconscious processes* (**LMUnc**) that has already been proposed to formulate the bi-logic framework presented a major difficulty, namely to question whether the combination of **LMUnc** and **LMCon** is equivalent to the underlying logic of the MBT. In other words, it means that we cannot claim combining any two logics together arbitrarily.

The second difficulty is about the preservation of the negation from **LMCon** to **LMUnc**. Mathematically speaking, given a negative proposition $p_1 \in$ **LMCon**, it can be mapped to another negative proposition $p_2 \in$ **LMUnc** by the sentence translation mapping (function). However, it has been claimed that the unconscious processes are *absent of negation* (Blanco 1988) (Blanco 1975) (Rayner 1995). Thus, a given negative proposition p_1 would become a positive proposition $p_{1'}$ in **LMUnc**, such that $p_{1'}$ is equipped with the same meaning as the negative proposition p_1 in **LMCon**. According to the first difficulty, we cannot have arbitrary combination of two logics. Here it implies that we can only pick the contradictory proposition either from **LMCon** or **LMUnc**. In this way, the contradictory proposition cannot be specified in a purely formal, but instead we have to check what "the meaning" and "the content" the propositions do really represent case by case. Here we encounter a difficulty: no contradiction that purely by means of *form* can be specified in **LMUnc**, as what we have always seen in formal logic.

Context-dependence logic

A potential framework which has been proposed by CJS Clarke (Clarke 2008) (Clarke 2006) (Clarke 2005) that the bi-logic framework is *context-dependent* could transcend the above-mentioned difficulties. The meaning of context-dependent is as follows: Given a proposition p, p may be true in one context but false in another. It argues that each conjunct of a formal contradictory conjunction $p \wedge \neg p$ might belong to a context in content.

Context-dependent logic will not be formalized, but realizing the context-dependence in the bi-logic framework is quite straightforward here. Given any proposition $+p$, $-p$, $+p$ means the positive propositions, $-p$ means the negative propositions, and the expression $\langle Q_x \mid R_y \rangle$ means propositions $Q \in x$, $R \in y$ have truth value with the simultaneous relation ($\mid$) and the unchanged context ($\langle\rangle$), we are able to list all possible cases for a proposition passing from the conscious processes to unconscious processes as follows:

Group (1)

1. $\langle +p_{con} \mid +p_{con} \rangle$
2. $\langle +p_{con} \mid -p_{con} \rangle$
3. $\langle -p_{con} \mid +p_{con} \rangle$
4. $\langle -p_{con} \mid -p_{con} \rangle$

Group (2)

1. $\langle +p_{con} \mid \neg + p_{con} \rangle$
2. $\langle +p_{con} \mid \neg - p_{con} \rangle$
3. $\langle -p_{con} \mid \neg + p_{con} \rangle$
4. $\langle -p_{con} \mid \neg - p_{con} \rangle$

Group (3)

1. $\langle +p_{con} \mid +p_{unc} \rangle$
2. $\langle +p_{con} \mid -p_{unc} \rangle$ (impossible case)
3. $\langle -p_{con} \mid -p_{unc} \rangle$ (impossible case)

Group (4)

1. $\langle +p_{con} \mid \neg + p_{unc} \rangle$ (impossible case)
2. $\langle +p_{con} \mid \neg - p_{unc} \rangle$ (impossible case)
3. $\langle -p_{con} \mid \neg - p_{unc} \rangle$ (impossible case)

* $\langle -p_{con} \mid +p_{unc} \rangle$ (absent of negation)

Group (5) We list the propositions in the non awareness states:

1. $\langle +p_{unc} \mid -p_{unc} \rangle$ (non awareness)
2. $\langle -p_{unc} \mid -p_{unc} \rangle$ (non awareness)

Group (6) We list all possible cases for the reverse proposition passing:

1. $\langle +p_{unc} \mid +p_{con} \rangle$
2. $\langle +p_{unc} \mid -p_{con} \rangle$
3. $\langle -p_{unc} \mid -p_{con} \rangle$ (impossible case)
4. $\langle -p_{unc} \mid +p_{con} \rangle$ (impossible case)

Group (7)

1. $\langle +p_{unc} \mid \neg + p_{con} \rangle$
2. $\langle +p_{unc} \mid \neg - p_{con} \rangle$
3. $\langle -p_{unc} \mid \neg - p_{con} \rangle$ (impossible case)
4. $\langle -p_{unc} \mid \neg + p_{con} \rangle$ (impossible case)

In the ordinary paraconsitent logical systems, we do not have to consider the persistence of context-dependency. However, due to the very essence of bi-logic framework, we have to make sure that a proposition follows the same context in the transition of two processes, such that we are able to handle paraconsistency, while we enter to and get out of the **LMUnc**.

Typically, any *formal contradictory* proposition $p \wedge \neg p$ was generated from the same one categories, that is the conscious processes. It is not from the unconscious processes because of the absence of negation. The *content contradictory* propositions are not restricted in this way. Hence, while we pick the contradictory propositions, it must be from 2 and 3 in group (1); 1 and 4 in group (2);*; 1 in group (5); 1 in group (7). Moreover, *the concept of inference* in **LMUnc** should be held in a manner of accepting the symmetry principle, of which a deduction will generate some new propositions.

In order to understand the transition processes between **LMUnc** and **LMCon**, let us discuss it in a bit more detail. The usual concept of inference that has already happened in **LMCon** would not happen as usual in the **LMUnc**. Two reasons are as follows:

- The *timelessness* in **LMUnc** would fail the concept of inference used in common, of which the time-serial (timeness) has always characterized the concept of the inference in the **LMCon**.
- The symmetry principle (or the absence of negation) will *trivialize* the concept of inference used in common (in **LMCon**).

With respect to the generalization of inference, we address a question: How could people simultaneously *grasp* that a set of propositions is inconsistent, of which contains p and negation of p, when p is derived at time$_1$ and the negation of p is derived at time$_2$?

While people are in the *awareness* state (or in conscious processes) with the certainty to the same context of two proposition p and $\neg p$, it is obvious that they will be confident of grasping a set of inconsistent propositions. Formally,

$$\langle p_x \rangle_a \longrightarrow \langle \neg p_x \rangle_b$$

$$\langle \neg p_x \rangle_a \longrightarrow \langle p_x \rangle_b$$

where 'p_x(or $\neg p_x$) in context a' comes before 'p_x(or $\neg p_x$) in context b'. The following one is to consider the first case in a more general but the same one context in the awareness state:

$$\langle \langle p_x \rangle_a \longrightarrow \langle \neg p_x \rangle_b \rangle_c$$

$$\langle \langle \neg p_x \rangle_a \longrightarrow \langle p_x \rangle_b \rangle_c$$

where $a = b = c$.

To be able to write down and be confident of this certainty could we only in the conscious processes, such that we have

ability to consider all relative normal procedures to the deduction. The deduction seems to be generalized (trivialized) in the unconscious processes and the processes between the unconscious and conscious processes. It is not surprised that the adoption of bi-logic framework via context-dependence is the only possibility after extending to grasp the inconsistency and the paraconsistency.

Conclusion and Discussion

As a result of this paper, we indicate that bi-logic framework could serve as the investigations for the formal studies of human mental processes. Specifically speaking, the study of the logic translation between paraconsistent logics. One of our future works is to paraphrase the bi-logic framework into this heavy mathematical favor one.

Next, we propose to develop the context-dependent logic to handle paraconsistency in the mental processes. For example, CJS Clarke has proposed a re-formulation of the bi-logic framework into a context-dependent logic. The formal definitions of 'context-dependent' and its direct relation to *topo theory* can refer the Clarke's paper (Clarke 2006). In other ways, Carlos Gershenson proposed several relative works (Cershenson 1999) (Cershenson 1998). He proposes the *multi-dimensional logic* "which is a new logic system proposed for modeling paraconsistency" (Cershenson 1999). His proposal intends to analyze different truth value for propositions, moreover to give different degrees of contradictions, i.e. it accepts more than one value of truth. To study and make the applications of multi-dimensional logics in the unconscious processes is another future work. Finally, it is worth of saying that dealing with the paraconsistent logics by proposing many-valued semantics could have been proposed (Béziau 2006).

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