

Advocacy on the Fascinating Integrative Neuroscience

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Editorial Article

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ABSTRACT

Herein it is highlighted the important integrative neuroscience with several recent fascinating breakthroughs: the neurobiological depiction of psychoanalysis, the neurobiological models of language, the advantages of cerebral asymmetry, and so on. It is concurrently pointed out that these theoretical breakthroughs would greatly benefit the application of integrative neuroscience, such as the improvement of therapy, the promotion of translation machines, and so on. It is expected to bring about good prospects to the inauguration of this new journal.

EDITORIAL

Theoretical modeling and integration has long been an important branch of neuroscience, especially for brain circuits and functions. Recently, there have been achieved several fascinating breakthroughs in theoretical integration of neuroscience, which not only greatly improve the comprehension of the relevant important brain functions, but also bring about the bright perspectives of applications. In this short editorial article, it is expected to introduce a few fascinating breakthroughs in integrative neuroscience recently, so as to advocate the excitement of integrative neuroscience to the readers.

The neurobiological depiction of psychoanalysis: It is advantageous to adopt such neurobiological terms and processes as the interactions and conflicts of the realities/memories with the instinctual drives to represent such terms and interactions as unconscious/preconscious/conscious, or id/ego/super-ego in Freudian psychoanalysis. During waking, learning or memory happens in all vertebrates ^[1,2], so that it is obvious that the interactions and conflicts of realities or memories with instinctual drives as Freudian psychoanalysis are present in both humans and other vertebrates. As to the rapid eye movement (REM) dream sleep, many experimental results have confirmed that it is involved in processing the emotional memories ^[3-7], while disrupting the emotional balance toward depression ^[8-10], supporting the Freudian psychoanalysis. As to the slow-wave sleep (SWS), it was demonstrated by Cai as ameliorating the depression caused by accumulated emotional memories ^[11-14], supplementing a new complementary half story neglected by Freudian psychoanalysis. Meanwhile, it was also pointed out by Cai that the differentiation of the noradrenergic and serotonergic activities in waking and sleep resulted in the differentiation of conscious and subconscious interactions and conflicts in psychoanalysis ^[11-14]. In all, with the convenience of neurobiological terms, it is successful to depict the neurobiological basis of psychoanalysis, while consolidate the scientific foundation of psychoanalysis. In perspective in application, as psychoanalysis emphasizes revealing the underlying psychological brain processes, it would be more accurate and scientific than the modern behavioral approaches and therapies, so that the neuropsychology would reoccupy the predominant role in psychiatric diagnosis and therapy in future.

The neurobiological models of language: Contemporarily, there are three types of neurobiological language models. (a) The declarative/procedural model is based on the anatomical lesion studies on semantics and grammar as the respective declarative and procedural memories ^[15-17]. However, this model has not considered the episodic association of words by meanings into various sentences. (b) The electrophysiological N400/P600 studies of language suggest that the change in N400 be usually related to the semantic mistakes while the change in P600 be frequently related to the syntactic/thematic mistakes ^[18-20]. Whereas, such explanation is oversimplified and exceptions have appeared in various forms ^[18-20], so that it is better to

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understand these explanations as the situations higher in probability^[18-20]. Besides, none of these relevant works has considered the qualitative difference between the syntactic and episodic associations of words. (c) The semantic/syntactic/episodic model recently proposed by Cai has extended the declarative/procedural model while suggested that the episodic association of words by meanings into sentence would moreover require the participation of reticular formations, encompassing the meaning of sentence into the neurobiological model^[21,22]. Many neuropsychological evidences can support this suggestion^[21,22], including: (i) The involvement of reticular dopaminergic system in the linguistic modality organization, as the dopaminergic antagonists alleviate^[23,24] while the dopaminergic genes phenotype^[25] the stuttering; (ii) The implications from drugs in many assisting therapies of aphasia that the ascending reticular cholinergic system, noradrenergic projections and nonspecific activating projections from intralaminar thalamic nuclei may participate in episodic coordination of cortical modalities in linguistic processes^[26]; (iii) The numerous reports that the gamma bands of high frequency, subject to modulation by the reticular cholinergic system, associate with the word congruency at sentential level^[27-29]. All of these neurobiological models of language have their own advantage and basis of supporting evidence. Scientifically they are all correct models with special orientation. Due to this reason, they are different in the perspective of application. With translation machine as example, the declarative/procedural model fits well with the present strategy of many softwares designed for linguistic correction in both spelling and grammar^[22]. The semantic/syntactic/episodic model fits the design of trained professional automated translation machines^[22]. The semantic/syntactic-thematic/prosodic model may specially be useful to translation of those contents containing prosody.

The advantages of cerebral asymmetry: There have been raised many theories about the advantage of cerebral asymmetry, briefly as followings: (1) cognitive benefits, especially spatial ability in adults and verbal ability in children^[30]; (2) semantic processing against interference^[31], such as stuttering; (3) alignment at population level by behavioral coordination or learning^[32,33]. (4) the long-term compatibility with left heartbeat during muscular contraction and limb movement, as proposed by a Chinese Member of Satellite Group^[34]. Among the four theories, the theory(3) and theory(4) can be the causative basis for the theory(1) and theory(2), while the theory(4) is more genetically heritable than the theory(3). In perspective, comprehension on the advantage of cerebral asymmetry can help improve the relevant clinical practices, especially those dealing with the movement, speaking, cardiovascular disease and so on.

Finally, it is necessary to point out that these three recent exemplary achievements illustrated in this article are by no means exhaustive to integrative neuroscience. The brain mechanisms for declarative memory consolidation and retrieval, the various forms of procedural memories, the formation of remote memory, the default brain circuit for self and emotion, and so on, are all important topics in integrative neuroscience, while mostly remain controversial. Introduction of the three recent fascinating exemplary achievements herein is aimed to demonstrate the exciting breakthroughs in integrative neuroscience to readers, as well as the potential perspectives of their applications. Hopefully, this article could bring about good prospects to the inauguration of this new journal.

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