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REVIEW ARTICLE

Evolution of Psychoanalytic Interactions and Conflicts in Vertebrates

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ABSTRACT

In this article, it is attempted to extend the Freudian psychoanalysis as the interactions and conflicts of the realities or memories with the instinctual drives to the vertebra subphylum in ecology and evolution. During waking, as learning and memory occurring in all vertebrates, it is obvious that the interactions and conflicts of realities or memories with instinctual drives are present in all vertebrate animals in waking in ecology. As to the rapid eye movement (REM) dream sleep, it is involved in processing the emotional memories, while disrupting the emotional balance toward depression. Recently, it was sketchily depicted the evolution of REM sleep as the early acquisition of atonic functions in reptiles, ostrich, and platypus, responsible for reduction of muscular tone and improvement of muscular efficiency, resulting in reduction in motivation from drives; the later addition of emotional memory processing in all mammals with desynchronized forebrain sleep; and the last addition of sexual drive dissipation in humans; so as to gradually establish the interactions and conflicts of learned memories with disinhibited drives during REM sleep in evolution. As to the slow-wave sleep (SWS), it was early demonstrated by Cai (*Physiology & Behavior, 50,* 53-60, 1991) as ameliorating the depression caused by accumulated emotional memories, supplementing a new half story neglected by Freudian psychoanalysis. It is well known that SWS is conserved in all higher vertebrates including mammals, birds and some reptiles, so are the functions of SWS supplemental to psychoanalysis. Herein, it is briefly demonstrated the evolution of psychoanalytic interactions and conflicts in vertebrates.

Keywords: Psychoanalysis, sleep, memory, depression, evolution, ecology

INTRODUCTION

Psychoanalysis has been a traditional theory on and therapy to many psychotic diseases. Freudian psychoanalysis has progressed significantly on both memory and emotion. It is the psychoanalysis of Freudianism that pointed out early that memories would undergo postlearning modification during both accumulation (Botella, 2014) and dream sleep (Habermas, 2014). It is also the psychoanalysis of Freudianism that pointed out early that the memories and emotions would affect with each other (Aguayo, 2014), which has made Freud become the most predominant pioneering representative of psychoanalysis. In this article, it is considered the applicability of Freudian psychoanalytic principles to the animal behaviors in ecology, and the evolution of them in vertebrates.

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The Psychoanalytic Principles of Freudianism during Waking

Freudian psychoanalysis is advantageous in that it provides the clear and systematic theories to illustrate

the interactions between the psychological cognition and instinctual drive in brain. Freud created the topographic theory early in his book "The Interpretation of Dreams", hypothesizing that the mental apparatus can be divided into the systems as unconscious, preconscious, and conscious (Bergmann, 2008; Psychoanalysis, 2016). Later, Freud revised the topographic theory into the structural theory, dividing the psyche into the id, ego, and super-ego (Bergmann, 2008; Psychoanalysis, 2016). The interactions and conflicts of three mental components in the topographic theory and structural theory represent the essence of Freudian psychoanalysis.

In humans, the contents of ego and super-ego are stored in the form of memory and language in long term, while all linguistic informations are also composed of remote and recent declarative memories, as well as procedural memories (Ardila, 2012; Cai, 2015a). Whereas, beyond memory and language, the intimate graphic and environmental inputs directly convey the realities to individuals. In this regard, in neurobiological terms, the interactions and conflicts of three mental components in Freudian psychoanalysis are all composed of the interactions and conflicts of both memories and realities to the instinctual drives (Cai, 2015b, 2015c, 2016).

During waking, as the interactions and conflicts of three mental components are constantly present according to the topographic theory and structural theory of Freudian psychoanalysis (Bergmann, 2008; Psychoanalysis, 2016), the interactions and conflicts of the memories and realities to the instinctual drives should also be constantly present correspondingly. According to the Freudian psychoanalysis, psychological disturbance occurs due to either failure in transformation of instinctual drives of id into the correct forms in ego and super-ego, or accumulation of aversive memories in the ego and super-ego (Bergmann, 2008; Psychoanalysis, 2016).

In similarity, in neurobiological terms, Cai also proposed that the emotional balance would be disrupted by the emotional memories accumulated during waking (Cai, 1991, 1995, 2015c, 2016).

The Freudian Psychoanalytic Interactions and Conflicts in Vertebrate Ecology

It is common knowledge that the instinctual drives are present in all vertebrates as hunger and sex during safe situations, while also as avoidance and aggression during aversive situations. Besides, in terrestrial vertebrates, thirst is added, while in mammals, thermoregulation and nurture is developed.

Learning and memory also occurs in almost all vertebrate animals. It has been demonstrated that hippocampal learning and memory is preserved from fish to reptile to mammals (Cai, 1990; Rodríguez et al., 2002).

With the neurobiological terms of psychoanalysis as the interactions and conflicts of the memories and realities to the instinctual drives, it is easy to extend the Freudian psychoanalytic principles to the vertebrates in ecology.

On the one hand, the preservation of hunger and sex during safe situations, as well as the preservation of avoidance and aggression during aversive situations in vertebrates, indicates that the instinctual drives are preserved in all vertebrates. Besides, the addition of thirst in terrestrial vertebrates, as well as the addition of thermoregulation and nurture in mammals, indicates that the evolution of the instinctual drives toward acquisition of more complex and comprehensive instinctual functions in higher vertebrates. All these instinctual drives correspond to the unconsciousness or id of Freudian psychoanalysis in humans.

On the other hand, the memories and realities can well be processed in the brain of all vertebrate animals, as demonstrated with the conserved ability of brain learning and memory from fish to reptile to mammals (Cai, 1990; Rodríguez et al., 2002). The responses and memories of the animals in ecology represent their ego of realities and memories, corresponding to the ego and super-ego in the structural theory of Freudian psychoanalysis in humans.

The Evolution of Freudian Psychoanalytic Interactions and Conflicts during REM Sleep

The dream function of rapid eye movement (REM) sleep in emotional regulation and memory processing has been a long historical subject. More than 100 years

ago, Sigmund Freud suggested that the instinctual wishes and drives should interact and conflict with the present realities and past memories in dreams. In 1969, Dement (1969) proposed that the REM sleep might function as energy or drive dissipation. In 1991 and 1995, Cai suggested that the REM sleep may function to complement the role of slow wave sleep (SWS) and shift the balance of emotion toward drive dissipation or even depression with retention of emotional memories accumulated during waking (Cai, 1991, 1995, 2015c, 2016).

The neurobiological experiments supporting the compatibility of REM sleep with Freudian psychoanalytic interactions and conflicts have been accumulated for long time. On the one hand, it was earlier suggested that the REM sleep play functions in memory retention (Cai, 1991, 1995) and retrieval (Cai, 1990, 1991, 1995). Recently, many experiments have shown that the REM sleep plays roles in retention of emotional memories (Baran, Pace-Schott, Ericson & Spencer, 2012; Groch, Wilhelm, Diekelmann & Born, 2013; Menz et al., 2013; Nishida, Pearsall, Buckner & Walker, 2009; Popa, Duvarci, Popescu, Léna & Paré, 2010). On the other hand, REM sleep deprivation was early reported as therapeutic against depression in humans (Vogel, 1975, 1983) and ameliorative against fear in rats (Hicks & Moore, 1979). Recently, there have also been many reviews demonstrating that the REM sleep tends to disrupt the emotional balance toward depression (Baglioni et al., 2014; Medina, Lechuga, Escandón & Moctezuma, 2014; Palagini, Baglioni, Ciapparelli, Gemignani & Riemann, 2013). In this regard, progressions for decades of years on functions of REM sleep in both memory and emotion have all been fitting well with Freudian psychoanalysis.

Recently, Cai sketchily depicted the evolution of REM sleep (2015b). The function of atonic REM sleep as improvement of muscular efficiency was early acquired in evolution in reptiles (Ayala-Guerrero & Huitrón Reséndiz, 1991; Ayala-Guerrero & Mexicano, 2008), ostrich (Lesku et al., 2011) and platypus (Siegel et al., 1999). Later, the retention of emotional memories was added to the REM sleep with forebrain desynchronization in mammals including armadillo (Affanni, Cervino & Marcos, 2001). Finally, disinhibition of sexual drives was added to the REM sleep in humans (Cai, 2015b). Whereas, the evolution for REM sleep to regulate the drives as hunger and thirst requires further investigation, even though the early acquired atonic REM sleep decreases the muscle tone while simultaneously decreases the bodily motivation from the muscle tone.

Likewise, herein it is in parallel worked out the gradual evolution of Freudian psychoanalytic interactions and conflicts during REM sleep in vertebrates. The atonic functions of REM sleep, to decrease the muscle tone for improving the muscular efficiency and resulting in reduction in bodily motivation, were acquired early in evolution in reptiles (Ayala-Guerrero & Huitrón Reséndiz, 1991; Ayala-Guerrero & Mexicano, 2008), ostrich (Lesku et al., 2011) and platypus (Siegel et al., 1999), so that the reduction of motivation from drives of Freudian psychoanalysis during REM sleep was also acquired early in evolution in reptiles, ostrich and platypus. Later, the retention of emotional memories of Freudian psychoanalysis in REM sleep was added as the desynchronized forebrain sleep in mammals including armadillo (Affanni, Cervino & Marcos, 2001). At last, the disinhibition of sexual drives in REM sleep of Freudian psychoanalysis was added to the humans (Cai, 2015b).

It is noted that, recently Horne also suggested that the REM sleep might function to transform the internal appetite on food into the 'optimal foraging' behavior of animals (Horne, 2009, 2013), compatible with the Freudian psychoanalysis of REM sleep as the interactions of the memories and realities to the instinctual drives (Bergmann, 2008; Psychoanalysis, 2016). Likewise, Horne (2009, 2013) advocated to extend the relevant investigations with the more ecological approaches.

The Evolution of Freudian Psychoanalytic Interactions and Conflicts during SWS

Cai demonstrated that SWS functioned to adjust the emotional balance disrupted by accumulated emotional memories, especially against depression (Cai, 1991, 1995, 2015c, 2016), opposite to the REM sleep. Shorter duration of SWS has been reported to be frequently associated with depression for decades of years up to

now(Baglioni et al., 2014; Medina, Lechuga, Escandón & Moctezuma, 2014; Mendlewicz & Kerkhofs, 1991), while sleep deprivation frequently results in negative mood disturbances characterized as depression, anxiety, frustration, tension and so on in healthy adults (Kahn-Greene, Killgore, Kamimori, Balkin & Killgore, 2007), and selective deprivation of stage 4 SWS in humans was reported to produce a depressive or hypochondriacal state (Agnew, Webb & Williams, 1967). Whereas, it has been successfully adopted for decades of years to help ameliorate depression by increasing the duration of SWS in early sleep with phase advance of sleep (Bunney & Bunney, 2012; Wehr, Wirz-Justice, Goodwin, Duncan & Gillin, 1979). In consistency, the high delta sleep ratio might help prevent the early recurrence of unipolar affective disorder (Kupfer, Frank, McEachran & Grochocinski, 1990). Besides, hippocampal lesion but not neocortical lesion caused impairment of SWS (Kim et al., 1971), while the neuronal activity in SWS increased in hippocampus but not in neocortex (McGinty & Szymusiak, 1988; Winson & Abzug, 1977). In all, it is evident that SWS plays a role in limbic and emotional regulation, especially against depression.

With regard to memory processing, it has been shown that SWS might help retention of declarative memory in humans (Inostroza & Born, 2013; Rasch & Born, 2013), while impair memory in emotional learning tasks in animals (Hars & Hennevin, 1987; Rideout, 1979). At the cellular level, it was shown that SWS favored LTD (Yang, Zhang, Wang, Ruan & Chen, 2012a, 2012b) but not LTP (Bramham & Srebro, 1989; Leonard, McNaughton & Barnes, 1987), while REM sleep was required for LTP (Ishikawa et al., 2006; Ravassard et al., 2009).

All these results have clearly demonstrated that SWS and REM sleep manifest opposite and counteractive in emotional regulation and memory processing (Cai, 1991, 1995, 2015c, 2016). In this regard, Cai recently put forward that the SWS supplemented a new half story of psychoanalysis on emotion and memory neglected by Freudianism (Cai, 2015c, 2016), extending the psychoanalysis from neurobiology.

It is noted that the evidences for decades of years have also demonstrated that total sleep deprivation in humans can produce an antidepressant effect to depression (Bunney & Bunney, 2012; Gillin, 1983; Wiegand, Riemann, Schreiber, Lauer & Berger, 1993), presumably mediated by changes in catecholaminergic metabolism (Gillin, 1983; Müller, Riemann, Berger & Müller, 1993). However, the effective duration of such antidepressant effect can last only for one or a few days (Bunney & Bunney, 2012; Gillin, 1983) or even shorter when naps interrupt the period of sleep deprivation (Gillin, 1983; Wiegand, Riemann, Schreiber, Lauer & Berger, 1993). Whereas, phase advance to increase the SWS following total sleep deprivation can prolong the transient antidepressant effect of total sleep deprivation (Bunney & Bunney, 2012), clearly demonstrating the transient nature of total sleep deprivation, and the long-lasting nature of SWS against depression.

In evolution, SWS is preserved in all birds and mammals (Cai, 1991, 1995), characterized as the synchronized slow wave during sleep in the forebrain. Even in dolphins without REM sleep (Madan & Jha, 2012; Sekiguchi, Arai & Kohshima, 2006), SWS is still present as alternative asymmetrical hemispherical synchronization (Madan & Jha, 2012; Sekiguchi, Arai & Kohshima, 2006), and even as many short periods a day, each lasting about 90 seconds in the Blind Indus dolphin (Pilleri, 1979).

Likewise, in evolution the new half story of psychoanalytic interactions and conflicts supplemented by SWS is also preserved in all birds and mammals, as adjustment of the emotional balance disrupted by accumulated emotional memories, especially against depression. It is characterized as the synchronized slow wave during sleep in the forebrain.

Perspectives

Extension of psychoanalysis to the ecological behaviors of animals helps to elucidate the evolution of psychoanalytic interactions and conflicts in vertebrates. It is perspective in that it provides the convenient animal models for the investigation of underlying brain mechanisms corresponding to psychoanalysis, as well as for the experimentation of relevant pharmacological mechanisms and effects.

It is necessary to point out that the neurobiological consistence and extension on Freudian psychoanalysis mainly results from the studies on depression rather than mania (Cai, 2016). As aversive learning occurs more frequently for most individuals in ecological environments, when extending such results from depression to mania, it is necessary to be cautious on whether the functions of SWS and REM sleep on emotional regulation and memory processing are still applicable to mania as to depression (Cai, 2016). Obviously, more investigations are required on this issue in future.

CONCLUSIONS

In this article, with the convenience of neurobiological terms of Freudian psychoanalysis as the interactions and conflicts of the realities or memories with the instinctual drives, it is extended the Freudian psychoanalysis from humans to the vertebra subphylum in ecology and evolution.

During waking, learning and memory occurs in all vertebrates from fish to reptile to mammals, so that the interactions and conflicts of realities or memories with instinctual drives in waking are present in all vertebrate animals in ecology.

During the REM dream sleep, it plays the role in processing the emotional memories, while disrupting the emotional balance toward depression. In evolution, the REM sleep early acquired the atonic functions in reptiles, ostrich, and platypus, for reduction of muscular tone and improvement of muscular efficiency, resulting in reduction in motivation from drives. Later there added the processing of emotional memories in all mammals with desynchronized forebrain sleep. Finally, there added the sexual drive dissipation in humans. These are also the depictions for the gradual generation of psychoanalytic interactions and conflicts of learned memories with disinhibited drives in REM sleep in evolution.

The SWS functions to adjust the emotional balance disrupted by accumulated emotional memories, especially against depression. SWS supplements a new half story neglected by Freudian psychoanalysis. SWS is conserved in all higher vertebrates including mammals, birds and some reptiles, characterized as the synchronized slow wave during sleep in the forebrain, so are the functions of SWS supplemental to psychoanalysis.

In all, these are the basic demonstrations on the evolution of psychoanalytic interactions and conflicts in vertebrates.

Conflict of interest

The author declares no conflict of interest nor financial support for this work.

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