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Are there Biological Evidences of the Influence of Social Networking Sites in Human Behavior? A Mini Review

Gilvan Aguiar da Silva[1]*and Seidel Guerra López[2]

[1]*Student of the master's degree in Biosciences at the Federal University for Latin American Integration of Brazil*

[2]*Medical Doctor and Professor of the master's degree of Biosciences of the Federal University for Latin American Integration of Brazil*

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***Corresponding author:** Gilvan Aguiar da Silva, Programa de Pós-Graduação em Biociências (PPG-BC) Universidade Federal da Integração Latino-Americana (UNILA). Av. Tarquínio Joslin dos Santos, nº. 1.000, edifício Ginásio, Sala nº. G-103-1, Bairro Jardim Universitário Município de Foz do Iguaçu, Estado do Paraná, Brazil, CEP nº. 85.870-901

Abstract

It is a fact that social and cultural interaction has an influence on decision-making processes and on the behavior of humans through the so-called reward mechanisms. The effects of a reward stimulus on behavior and decision can be observed in the human brain through the activity of a specific circuit of reward that consists of the orbitofrontal cortex, striatum and amygdala, with dopaminergic modulation. These interactions are also sometimes called the mesocorticolimbic system. This mechanism is present in other animals and mammals and probably emerged as an advantageous feature allowing species to adapt to the environment. However, the dysfunction of this system is associated with several neuropsychiatric disorders, such as autism spectrum disorders, schizophrenia or drug addiction. In this context, it is well known that social networking sites have revolutionized the form of social and cultural interactions, connecting millions of people in real time and leveraging the social reward mechanism in individuals. Furthermore, social networking sites have been used as important tools for the dissemination of ideas that directly impact people's lives, from the philosophical, scientific and even presidential campaigns. Meanwhile, the possible neurological effects of this new form of social interaction are still poorly studied and important questions need to be answered. In this paper, we discuss some of these issues.

Keywords: Social networks sites; Human Behavior; Social Reward

Introduction

It has been accepted that the social interaction can influence human decisions and behaviors. Several studies in the field of cognitive neuroscience have shown that human behavior and decision-making processes are directly influenced by so-called reward mechanisms [1-4]. Some authors classify these rewards into two distinct classes. First, the tangible rewards that generate direct physiological effects (for example, food or drugs) that are referred to as primary rewards. The other category is made up of abstract rewards, or which have no direct physiological effect (for example money), which would be the secondary rewards [5]. So, there needs to be a human brain biochemical circuit that integrates these rewards. Thereby, rewards influence behavior. The effects of a reward stimulus on behavior and decision can be observed in the human brain through the activity of a specific reward circuit that consists of the orbitofrontal cortex, striatum and amygdala, with dopaminergic modulation [5,6]. These interactions are also sometimes called the mesocorticolimbic system. The dopaminergic mesocorticolimbic system acts as a motivational circuit that translates biologically relevant stimuli, including environmental and pharmacological ones, into behavioral responses, mainly through the neurotransmitter dopamine. Anatomically, this system begins in the Ventral Tegmental Area of the midbrain (VTA) and forms a connection with the limbic system through the Nucleus Accumbens (NAcc), the cerebellar amygdala and the hippocampus, and also with the medial prefrontal cortex. This interconnection of several cores to each other, allows a relatively fluid circulation of information from the portion occupied by the cores to the pyramidal and extrapyramidal motor systems. In addition, the amygdala also sends connections to the system conforming what we know as the extended amygdala [5,6]. Thus, cultural and social rewards are part of the classification of secondary rewards. Moreover, studies

of these dopaminergic pathways in humans suggest that there is a distinct cultural and social influence in defining preferences for secondary type rewards. For example, the decision on the choice of liquid sugar-based drinks (soft drinks with the same flavor, however, different brands) and even types of cars, are influenced by the individual's social and / or cultural contexts [5,7]. These cultural rewards are represented in the medial orbitofrontal areas of the brain. Whereas the representation of social rewards occurs mainly in the dorsal striatum. Both social and cultural rewards are the result of a need for group interaction inherent to mammals [3,5]. Thus, this mechanism is commonly called social/cultural reward.

Therefore, the orbitofrontal cortex is mainly involved in assigning value to a stimulus during the delivery of the reward. The striatum and amygdala, on the other hand, are involved in the formation of representations of the expected reward value of a stimulus and constantly update such representations to reflect on the current motivational state or changes in reward properties (for example, probability and time of occurrence). Other animal species have also developed the social/cultural reward system (secondary rewards of the intangible type). The neural circuits that govern the behavioral mechanism for social reward, probably appeared at the beginning of the evolution of vertebrates and are also present in birds, reptiles, bone fish and amphibians, in addition to mammals [2]. It is possible to conclude that, in certain species, individuals with a tendency to socialize in groups may have benefited from the evolutionary process of natural selection, becoming less prone to predators, in confronting rival groups, saving energy, etc. In fact, the species itself can in theory benefit from this type of behavior. The beginning of studies in this line of research dates back to Charles Darwin when he proposed that both the singing and dancing of birds, as well as human music and dance were promoted by sexual selection [8]. In this regard, Israeli zoologist Amotz Zahavi in an influential article published in 1975 [9], helped to coined the term potlatch effect, when he analyzed the behavior in altruistic thesis of small male Arabian zagateiro birds that feed other males. Theoretically, what evolutionary advantage could be derived from strengthening another male who in the future would be a rival in choosing a female? In the zoologist's conclusion, the zagateiros exercise their dominance by feeding the subordinates, a demonstration of strength and superiority, which ultimately guarantees the females of the group and, consequently, a greater probability of generating descendants.

In another experiment [10], the experimental condition called Conditioned Place Preference (CPP) for cocaine (15mg/kg), where rats are conditioned to choose a particular compartment in exchange for receiving the stimulus (cocaine injection) has been completely reversed in experimental group rats by conditioning social interaction (with only 4 episodes of 15 minutes each). Studies like this demonstrate how strong the impulse for social reward can be, competing and directly overcoming the compulsion for cocaine (primary reward mechanism), a substance known for its strong tolerance and addiction effects. This experiment also demonstrated biological evidence that social interaction reversed the cocaine-induced CPP expression of the immediate-early zif268 gene, in several areas of the brain known to be involved in the reinforcement and reward of drugs: in the shell of the nucleus accumbens (NAcc), in the central and basolateral amygdala and in the ventral tegmental area. This demonstrates that the results are supported not only by behavioral experiments, but also by direct biological evidence of their mechanism [10]. Currently, the recent combination of genetic and behavioral tests with a cutting-edge approach called multifiber photometry, in which light can turn specific cells on and off, adds to this evidence. This technique has already made it possible to stimulate and measure the activity in neurons identified in the reward pathways, with an excellent degree of accuracy of rats in social environments [6]. Multifiber photometry has revealed that the activity dynamics of an VTA projection for NAcc could encode and predict key characteristics of social interaction. For example, a recent study showed that a specific group of these dopaminergic neurons within these mesocorticolimbic reward loops is stimulated when a mouse encounters a new mouse from its own genetic line, which it has never known before. This reward reaction via the neurotransmitter dopamine may be the corollary of human group recognition [6]. Thus, several studies [4,11,12] have proposed to contribute to the understanding of the functioning of more complex cultural / social rewards of human interactions (for example trust, love, respect, recognition of peers, etc.).

Conclusion

As demonstrated, this strong body of evidence allows us to conclude that human behavior and decisions are influenced by direct social / cultural rewards, as in the case of an individual benefiting or suffering loss when interacting with others in a game, and also by social / cultural stimuli of indirect benefit, such as feelings and emotions (such as love and humor), affirmation before the group, or friendship. Therefore, social rewards can promote very strong impulses, possibly even able to overcome addiction induced by drugs of abuse (cocaine) in the decision and choice process. In this context, it is known that social networks have revolutionized the form of social interactions, connecting millions of people in real time and leveraging the social reward mechanism in individuals. However, the possible neurological effects of this new form of social interaction are still poorly studied. For example, considering the "likes" mechanism. This type of mechanism probably generates a strong social reward and a sense of pleasure when sharing content. Would it be possible for a user of this type of social networking site to be exposed to conduct similar to those carried out in laboratories as in the case of CPP? That is, a kind of conditioned training of opinions or behavior? For example, would it be possible for the user of a given social network to assimilate the most accepted behavior in the group with regard to the type of content (photo, text or video) to be shared? With regard to shared opinions, there could be a tendency not to share subjects with a low probability of approval

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by others (low probability of receiving likes), such as technical, complex or even controversial issues from the point of view of the majority. of people in a particular community? The subject is extremely relevant, recently several media outlets revealed how a group would have tried to influence an important decision in the United Kingdom (with respect to Brexit), using sophisticated algorithms that would have been produced by the company Cambridge Analytica. These facts were even portrayed in a film [13]. Respected news sites [14-16] indicated that the same company also influenced the electoral process in the United States (USA), through the same mechanisms. Besides that, it was also widely reported [17,18] that the current President of Brazil (Jair Bolsonaro) was also elected through a controversial campaign that would have started through funny videos on social networks and later was given almost exclusively through those same networks. This news are also confirmed by an article in English available on the website of the Institute for Socioeconomic Studies of Brazil [19]. In Ukraine, a similar fact occurred, it was reported [20] that comedian Volodymyr Zelenskiy was elected president in a campaign focused on funny videos on social media. Therefore, it is essential that new research in different areas of neuroscience dedicate themselves to answering important questions such as: Biological evidence suggests that social networking sites can influence human behavior? Is it possible to understand these mechanisms and to predict general trends in behavior with information taken from social networks? And mainly Knowing the mechanisms and having the right tools, is it possible to induce behaviors and decisions through social networking sites?.

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