Biological Psychiatry

Commentary

Social Homeostasis: A New Paradigm for Mental Health Diagnosis and Treatment

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The Mental Health Crisis and the Loneliness Epidemic

We are in a global mental health crisis fueled in part by the convergence of world events such as the COVID-19 pandemic, climate crises, war, economic hardship, and political turmoil as well as an epidemic of social disconnection that undermines emotional resilience in the population. The resulting distress and isolation compound the impact of impairments in social cognition and social function intrinsic to most psychiatric disorders (1). Despite the tremendous unmet need for treatments specifically targeting symptoms in the social domain, there are no treatments approved by the U.S. Food and Drug Administration for these impairments and symptoms (2). Recent advances in social neuroscience may help frame both the opportunities and challenges for understanding and treating social deficits in new ways that may make both scientific progress and treatment development more tractable.

Social homeostasis has emerged as a leading mechanistic framework for understanding the neurobiology governing social dynamics (3,4); however, there has been limited application to the field of psychiatry. Social homeostasis provides a model for understanding the drivers of adaptive and aversive social interactions and how they lead to or impact stress. Social homeostasis posits that the drive for social connection is innate and that evolutionarily conserved neural systems underlie the maintenance of social connections through the ability of individuals to detect the quantity and quality of social interactions, compare it with an established set point, and adjust the effort expended to seek optimal social contact. This framework provides a model through which shifts in social dynamics modulate brain networks that regulate other homeostatic processes, such as autonomic regulation, which drives stress physiology relevant to psychiatric symptoms (5,6) (Figure 1). It also provides a context to understand the complexity through which the quantity and quality of social contacts can influence health and behavior. For example, an individual's involvement in a group can lead to social pain or social buffering from pain depending on the quality of the social interactions and the nature of the environment. In addition, one can have an aversive stress response to both isolation and overcrowding. Lastly, depending on the environmental and social context, subordination in a group may be more stressful for an organism than isolation (7). The ability of social homeostatic processes to flexibly respond to dynamic changes in stimuli allow for a model that can account for these nuances through changes in detector, control, and effector circuits.

This special issue of *Biological Psychiatry* conveys evidence supporting the social homeostasis model and presents evidence that disturbances in social homeostasis could account for symptoms of mental health conditions such as depression, anxiety, substance abuse, and schizophrenia. We also highlight how prolonged social isolation during COVID-19 may have disrupted social homeostasis and thereby worsened the global impact of mental illness. We then provide evidence that the rising use of social media, particularly by adolescents, might alter social homoeostasis, contributing to the pronounced rise in mental illness rates in this segment of the population. Lastly, this issue considers the application of social homeostasis to psychiatric treatment.

Social Homeostasis as a Framework for Mental Health

Holt-Lunstad and Sine (8) contextualize the critical issue of loneliness and its implications for public health, particularly exacerbated by the COVID-19 pandemic. They discuss the social homeostasis model as a framework for understanding how social connection, rather than merely reducing loneliness, can address broader health crises. They propose systemic solutions, such as strengthening social infrastructure and promoting public policies that foster social connection, as essential strategies for mitigating the long-term impacts of social disconnection.

Li *et al.* (9) review the historical and conceptual evolution of social neuroscience and its application to psychiatry. They highlight that patients with serious mental illness (SMI) have varying degrees of social dysfunction that decrease quality of life and exacerbate life-threatening psychological and physical sequelae such as cardiac disease. Social neuroscience provides mechanistic insights into neural mechanisms underlying these social deficits. They highlight early work by Harlow and Zimmermann (10) that challenged the notion of behaviorism by showing that during development, nonhuman primates would respond to soft, inanimate objects with attachment and social behavior. They trace the development of the field from the early work of Tinbergen (11) and Lorenz (12), which highlighted the adaptive significance of social hierarchy, mate selection, empathy, and cooperation to more constrained paradigms that have been the standard of social behavioral neuroscience such as the resident-intruder task. Li *et al.* promote more naturalistic social contexts as models to study the significance of relationships in psychological development and their clinical implications for mental health professionals working with patients with SMIs.

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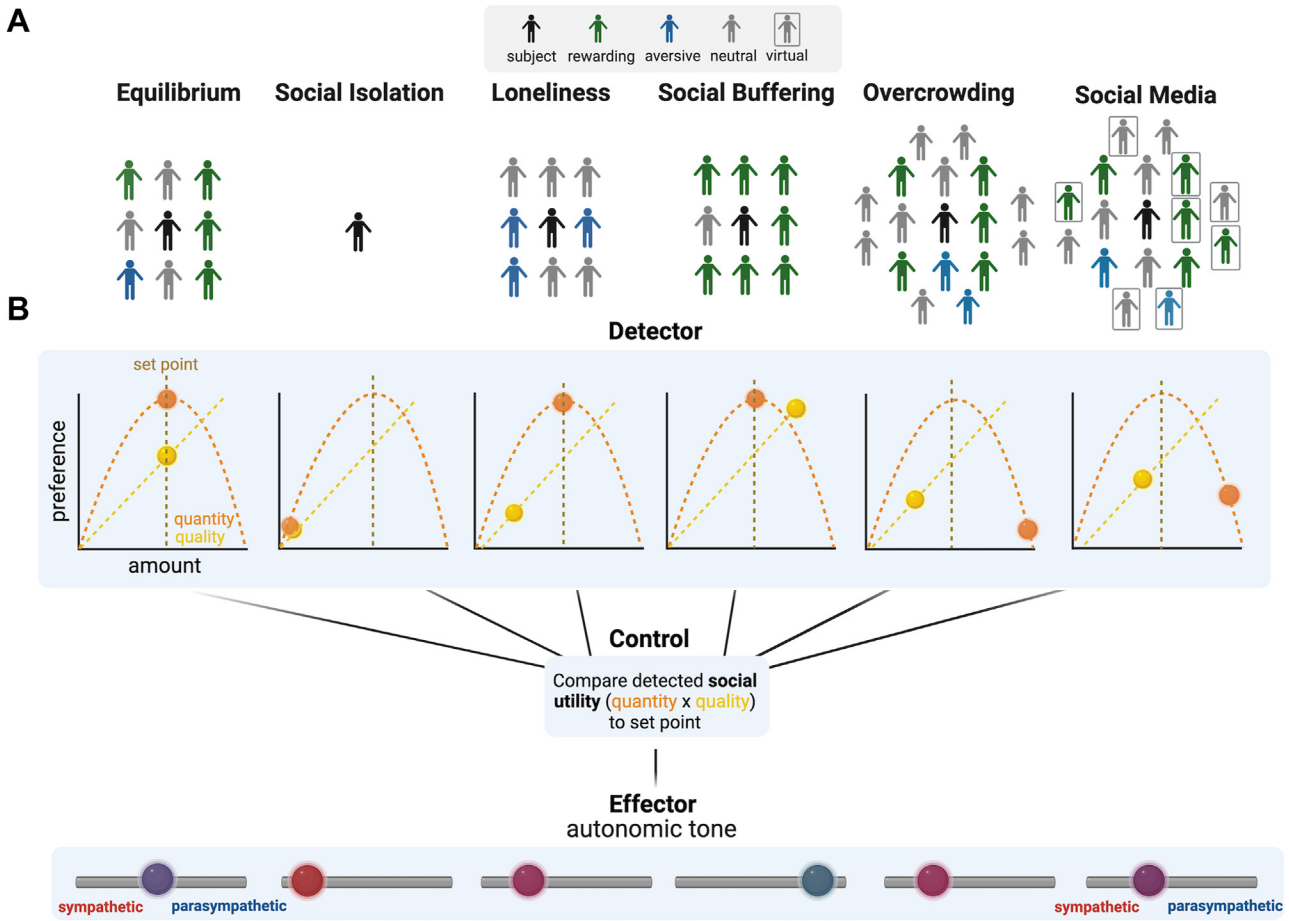

Figure 1. Integrating social homeostasis and autonomic physiology. **(A)** A subject is placed in various acute social contexts defined by 1) the number of live and virtual social interactions in the observed social network and 2) whether each interaction is valued as rewarding, aversive, or neutral. These interactions are used as the inputs for the social homeostatic system. **(B)** A detector measures the quantity and quality of interactions in the social network to calculate social utility (social utility = quantity × quality) (4). The control center compares the measured social utility to a set point. In this case, the control center sends a signal to an effector system that controls autonomic tone and shifts sympathetic and parasympathetic balance to acutely respond to the detected social context. During social media use, the quantity of social inputs can increase, although the quality of the interactions may be less valued than live interactions. Over time, chronic states of isolation, loneliness, or overcrowding could shift the set point, leading to autonomic imbalance, a hallmark of various psychiatric conditions.

Translatable Neural Mechanisms for Social Homeostasis

Social homeostasis provides a framework that can be translated across model systems, providing a powerful opportunity to discover neural mechanisms underlying social dysfunction in psychiatric conditions. Asahina and Zelikowsky (13) focus on molecular mechanisms and provide a comparative analysis of neuropeptide functions across rodents and *Drosophila*, highlighting how social isolation induces changes in social and nonsocial behavior. They focus on 3 neuropeptidergic families—tachykinins, cholecystokinins, and neuropeptide Y/F—illustrating their conserved roles in modulating behaviors related to social isolation. This cross-species approach suggests that understanding these molecular mechanisms that are also involved in autonomic nervous system function can guide targeted interventions in psychiatric diseases.

Lee and Williams (14) consider the converging evidence across species for the role of the prefrontal cortex (PFC) as a control center for social behavior and its implications for psychiatric disorders. They examine how disruptions in PFC circuitry contribute to conditions like depression and anxiety, advocating for further research into PFC-targeted treatments. In addition, they discuss the impact of modern factors such as social media on mental health, urging the exploration of contemporary disruptions to social homeostasis and how it might affect development of regions like the PFC. Interestingly, the PFC is also a hub for autonomic nervous system modulation (6).

Rigney and Hong (15) explore the conceptual and neural mechanisms underpinning prosocial helping behavior, highlighting the potential of animal models to translate complex social behaviors that facilitate social connection. They distinguish between various forms of helping—targeted assistance, sharing, and comforting—and their roles in fostering social cohesion. They provide evidence for regions such as the anterior cingulate cortex, medial amygdala, and paraventricular nucleus of the hypothalamus as being critical for prosocial

helping behaviors. They also highlight the bidirectional relationship between social experience and prosocial circuits, emphasizing the need for mechanistic studies to understand their impact on social homeostasis.

Homeostasis and Mental Health Symptoms

Maladjustments in social homeostasis may be a general mechanism for the development of psychiatric symptoms. We provide evidence from human observational and behavioral studies to support this model. First, Løseth *et al.* (16) demonstrate the link between loneliness and increased risk of opioid addiction. They discuss how μ opioid modulation affects social bonding and how disruptions in opioid signaling can perpetuate substance use. They advocate for enhancing patients' social resources to improve addiction recovery, highlighting the translational potential of animal studies to human research. Bershad and de Wit (17) further examine the interplay between psychoactive drugs and social homeostasis, using opioids and amphetamines as case studies. They discuss how these substances temporarily alleviate social isolation and promote social connections yet also potentially contribute to substance use disorders. The endogenous opioid system is also involved in modulating autonomic nervous system activity. The authors call for more research to understand how these compounds affect social processes and the implications for developing pharmacological treatments targeting social disequilibrium.

Conditions such as migration, solitary confinement, and pandemics provide real-world opportunities to understand the impact of mass human social isolation on behavior and mental health. During the COVID-19 lockdown, Stijovic *et al.* (18) investigated the affective and social predictors of food consumption. Their study links momentary psychological states to prospective food consumption and shows how this basic autonomic physiological function is moderated by social interactions and social connection. They found that positive social interactions enhanced the effects of mood valence on food consumption and suggest that food may have been used to maintain positive affective states during the COVID-19 lockdown.

Lastly, the impact of social media on social homeostasis and mental health symptoms is complex. It highlights how the evolution of technology may fundamentally shape social homeostatic setpoints. Turner *et al.* (19) offer a computational framework of reinforcement learning (RL) to understand human behavior in the context of social media. The analysis indicates that certain social media features exploit RL biases, potentially leading to maladaptive behaviors. They emphasize the importance of understanding these dynamics to address the psychological impact of digital environments.

Integrating Social Homeostasis Into Psychiatry

As the field integrates principles and practices from social neuroscience into psychiatry, studies emphasizing naturalistic animal behaviors and real-world human behavior will shed light onto mechanisms underlying mental health disorders. Many articles across flies, rodents, and humans highlight the detrimental effects of social isolation on animal behavior, autonomic physiology, and human mental health. The data collectively demonstrate the importance of social connections in maintaining well-being. Thus, we emphasize an understanding of the neural mechanisms that drive social connection and prosocial behavior. These behaviors play a crucial role in maintaining group cohesion and social structures and can provide key insights to end the loneliness epidemic. Networks involving regions such as the PFC are likely critical for the detection and set point of social homeostasis and also regulate autonomic physiology. Autonomic imbalances between sympathetic and parasympathetic drives have been found in stress-related conditions such as anxiety and depression. Through changes in set point and effector mechanisms, social isolation may lead to the autonomic imbalance that is seen across various psychiatric diseases.

There is great potential in combining social dynamics with pharmacological treatments as demonstrated by the early results from psychedelic-assisted psychotherapy for posttraumatic stress disorder. In addition, enhancing psychosocial resources will be a critical strategy for improving mental health outcomes. There is an intricate relationship between social homeostasis and mental health. We can develop more effective interventions for mental health disorders by integrating social neuroscience with psychiatry, exploring neurobiological mechanisms, and addressing contemporary socio-environmental challenges.

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Article Information

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