cient, and making platform security a design and research priority may help reassure reluctant users.

Another challenge is the confusing legal landscape within which telepsychiatry practice occurs. Depending on the country, this may involve adhering to a complex web of federal and regional legislation. In the US, for example, treatment must adhere to federal laws that predate current telemental health tools (e.g., the Health Insurance Portability and Accountability Act of 1996). The result may be that crucial questions in telepsychiatry practice remain unanswered, such as whether ubiquitous tools like FaceTime and Skype meet the requirements of health care technology legislation. Also, in the US, where licensing laws are regional and deem care to occur in the state where the patient resides, cross-state treatment is severely limited, a reality that neutralizes a key telemedicine value proposition – correcting shortages in access to care.

The dearth of guidance from leading professional organizations has also limited telemental health adoption. The first major telemental health initiatives by the American Psychiatric Association and the American Psychological Association, for example, date back only to 2015 and 2011, respectively. This has contributed to confusion among practitioners regarding treatment "best practices", remote management of emergencies, reimbursement, insurance coverage, malpractice protection, documentation, product vetting, and security. More guidance is required if providers are to embrace promising novel treatments that may come with heightened risks.

Further, certain telemental health tools have not escaped automatic comparisons with video games or other online or technology-enabled entertainment. This is particularly true within the field of "serious games", defined as video games with educational or therapeutic goals[4], and virtual reality therapy. Especially when infrastructure investment can be significant, interventions that are perceived as entertaining but not necessarily therapeutic will struggle to gain footing.

Indeed, infrastructure, while significantly less expensive now, as evidenced by the decrease in the price of virtual reality equipment[5], is still not universally affordable. This represents an ongoing challenge to wider adoption; one that mirrors technical know-how, which – while no longer the obstacle it was, due to increased technology literacy and ever more "plug and play" models – still represents a challenge in certain populations.

The unmet needs in mental heath care are too large to be addressed without leveraging technological innovations. Mental health care is particularly well suited to benefit from telemedicine advances, but several obstacles have made it so that the telemental health revolution, with its promised solutions, has not yet arrived. Concerted efforts by funding agencies, researchers, engineers, public health authorities, professional organizations, and legislative bodies are needed if the hope is to translate into real-life improvement.

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The brain's center of gravity: how the default mode network helps us to understand the self

The self is an elusive concept. We have an intuitive sense as to what it refers to, but it defies simple definition. There is some consensus that the self can be broadly separated into what W. James referred to as the "I" and the "me" – the self that experiences, and the self that extends outwards in space and in time, allowing it to be perceived as an object[1]. This includes the self as physical object (the body), and as an abstract object with beliefs and attitudes. Divisions of the self similar to James's have been suggested by Damasio (the core and the autobiographical self)[2] and Gallagher (the minimal and the narrative self)[3].

The philosopher D. Dennett has defined the self as "the center of narrative gravity"[4]. This definition encapsulates the idea of the self as both the center of experience, and one that is situated in a broader and ongoing narrative. In using the center of gravity as a metaphor for the self, Dennett wanted to highlight that it – like the self – is an abstraction, having no physical properties. The center of gravity exists only as a concept, but one that is useful for predicting an object's characteristics (at what point will it tip over?). So it is that the self can be viewed: as a useful abstraction that we can all agree exists in a broad sense, but which cannot be precisely defined in physical terms.

Dennett argued that "it is a category mistake to start looking around for the self in the brain"; and that he couldn't imagine us ever saying: "that cell there, right in the middle of the hippocampus (or wherever) – that's the self!"[4]. He is right in the sense he discusses: we cannot locate the self in a particular region of the brain. But modern neuroimaging techniques have been able to reveal that aspects of the self are associated with the dynamic coordinated activity of a large-scale brain network. This network is referred to as the default mode network (DMN).

The DMN is composed primarily of medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC), both situated along the brain's midline, together with inferior parietal and medial temporal regions. The network was first observed in nuclear imaging studies, where it was noted that the regions consistently showed *reduced* levels of activity when participants performed various goal-directed tasks[5]. The regions were described as comprising a "default mode" because it was thought that the pattern of activity was what the brain defaulted to in the absence of particular task demands[6]. This hypothesis has since been confirmed by other observations, including studies that have examined resting-state functional activity of the DMN.

The idea that DMN function underlies self-related processes has been demonstrated by experimental tasks, as well as by studies of participants who show reduced self-awareness (for example, as they enter sleep or anesthetic states). Overlapping regions of the DMN are generally activated by tasks that encourage self-reflection, with evidence of differential patterns of activation to task components.

The anterior DMN – and especially dorsal MPFC – is more broadly activated by self-directed thoughts: for example, by the effortful appraisal of one's attributes, or thinking about the self in past and future contexts. The posterior DMN, on the other hand, is more broadly active during passive resting-state conditions. It integrates spatial and interoceptive representations of the body, along with low-level surveillance of one's surroundings.

We have recently examined how MPFC and PCC act in concert during self-referential processing, showing that PCC appears to coordinate the generation of relevant self-representations, while MPFC acts to select and gate the representations into conscious awareness[7].

Imaging "connectomic" approaches, which explore how regions of the brain interact with one another from a dynamic whole-brain perspective, have shown that the MPFC and PCC have among the highest degrees of global connectivity, serving as hubs in the brain's overall network organization[8]. The regions act at the intersection of large-scale networks, where they integrate information from diverse sources – including from self-relevant sources such as autobiographical memory and interoceptive processes. Evidence from connectomic studies suggests that the DMN is unique in its capacity to integrate information processing across the brain, allowing it to support the generation of higher-order, self-related mental activity.

Brain networks must affect motor output to influence behavior. The MPFC has rich connections with the hypothalamus and midbrain autonomic control centers, thereby influencing affective, visceral and behavioral responses to events[9]. The hypothalamus drives tendencies to fight, flee, feed and fornicate (the famous "4 Fs"), as well as influencing sleep, energy levels, and other neuroendocrine processes. By means of these systems, the DMN influences the state of the body, and the way it is represented by internal processes, which we hypothesize become dynamically re-integrated with higher-level DMN self-representations. The DMN therefore coordinates a sense of self that spans cognitive abstractions about the self with a more grounded awareness of the state of the body in the here and now.

The center of gravity was introduced by Dennett as a metaphor for how we might understand the self; as a useful abstraction that we cannot define in terms related to its physical properties. Here, we propose extending that metaphor to illustrate the role of the DMN.

The center of gravity is a dynamic property of complex moving objects, such as the human body. It is created from the sum of variables related to the mass, shape, acceleration and rotation of the object's interacting parts, and shifts with movement. In the act of bipedal walking, for example, the center of gravity is propelled forward with the generation of movement, and must be constantly adjusted so that our bodies remain upright over uneven terrain.

It is in this light that we can recognize the role of the default mode network: as a dynamic entity that sums the activity of, and interaction between, other large-scale systems across the brain. The DMN acts to coordinate network integration to influence the body's response to events, thereby supporting flexible, adaptive behavior in complex environments. It is from this activity – which creates "a center of narrative gravity" – that our sense of ourselves emerges.

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