signals on the phone rather than sending data to the cloud have the advantage of keeping raw data local and private. And other approaches, such as Google takeout, that empower users to monitor their own data can avoid the sense of surveillance.

Some have claimed that the smartphone is more the source than the solution for mental disorders[7]. As phones kidnap our attention and remove us from real world interaction, this worry seems increasingly urgent, especially in young people who are the most intensive smartphone users. On the other hand, the smartphone may be an unprecedented opportunity to measure real-world functioning and potentially to offer just-in-time interventions.

All new technologies face this dual-use dilemma between risk and benefit. For digital phenotyping, this is the time for patients, families, providers and researchers to define together the balance between clinical value and public trust.

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DOI:10.1002/wps.20550

# Telemental health: why the revolution has not arrived

Mental illness is often underdiagnosed and undertreated. Several obstacles help explain this public health problem, including provider shortage, difficulty accessing care, cost, stigma, and a variety of diagnosis-specific issues. By promising to broaden access, increase efficiency, decrease costs, and remove stigma, telemental health has been touted as a solution[1].

However, despite three decades of often encouraging investigations across several technology platforms (computerized therapy, Internet-delivered video- or chat-based treatment, mobile therapy, "serious games", and virtual reality therapy), significant challenges continue to limit the wide adoption of telemental health interventions. They include: the present state of research; the rise of "coaching"; attrition rates; security concerns; legal confusion; insufficient guidance from professional organizations; comparisons with gaming; and the still relevant obstacles of infrastructure cost and technical know-how.

Most telepsychiatry studies are too small and unrepresentative, and lack the control of in-person treatment. Consequently, they limit broad recommendations in favor of adoption. The discrepancy between the slow pace of research (the process of funding procurement, protocol design, institutional review board approval, recruitment, testing, data analysis, peer review, and publication) and the breakneck pace of technology also limits the value of existing studies. By the time a well-designed trial generates data, the platform may be outdated or less appealing given more sophisticated alternatives now available. This can mean that research-based recommendations often lag available offerings. It can also mean that marketing by well-funded health technology companies can be divorced from the evidence base, with serious regulatory consequences[2].

Paradoxically, the rise of "coaching" may have also limited telemental health adoption. Many studies have set out to prove that adequate psychotherapy can be implemented with little or no support from professionally trained providers[3]. This mirrors the move in broader psychotherapy from the interpretive therapist to one following a standardized cognitive-behavioral therapy (CBT) model. Less reliance on therapists would be laudable if it democratized care. However, one consequence may have been to depend on "coaches" who need no particular training or licensing, and who provide support while eschewing direct "treatment". As a result, medical professionals can now be entirely bypassed: many patients already self-diagnose via "Dr. Google" and, now, they can self-treat using telepsychiatry tools, with or without the help of a "coach". This can lead mental health providers to view telepsychiatry as a potential competitor that aims to supplant them with lesser-trained individuals (or standalone platforms). Consequently, they may hesitate to recommend telemental health services.

Treatment adherence represents another challenge, and studies have suggested higher attrition rates compared to conventional treatment[1]. While analyzing the patient-therapist relationship is no longer a cornerstone of treatment, having no relationship (e.g., standalone computerized CBT) or a very limited one (e.g., online CBT modules with minimal therapist contact) may preclude a "therapeutic alliance", thereby perhaps decreasing motivation to engage in treatment. Ingrained online habits, where relationship "termination" is as easy as the click of a button (e.g., "unfriending" or "blocking"), may also contribute to poor adherence to a telepsychiatry provider and telepsychiatry interventions.

With frequent news of hacks into supposedly secure networks, questions arise about the possibility of safeguarding digital platforms, presenting another challenge to the practice of telepsychiatry. Telemental health research has not prioritized testing limits, expectations and views around security. Yet, this is a crucial determinant of adoption for both patients and providers. Simply stating a platform is encrypted is insuffi-

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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DOI:10.1002/wps.20551

# 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