

# The Promise and Perils of Behavioral Measurement Technologies

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When the coronavirus pandemic relocated millions of workers from their offices to their homes, many of their employers began monitoring them remotely, often on a minute-by-minute basis, through surveillance technologies such as facial recognition and keyboard and web-browser tracking. Remote worker monitoring is just a recent example of an accelerating trend playing out all over the world. At thousands of time points every day, people feed behavioral data into a multitude of measurement tools, ranging from mobile health apps and wearable fitness trackers, which monitor performance at the individual level, to street cameras, web browsers, and smartphones, which surveil individuals' whereabouts and activities. In a forthcoming issue of [Current Directions in Psychological Science](#), 13 teams of researchers review existing research on the individual and social consequences of behavioral measurement technologies (BMTs)—their promise and perils alike.

BMTs “offer the promise of helping us to know ourselves better and improve our well-being by using personalized feedback and gamification,” writes Rob Goldstone, the journal’s editor, in his introduction. “At the same time, they present threats to our privacy, self-esteem, and motivation. At the societal level, the potential benefits of reduced bias and decision variability by using objective and transparent assessments are offset by threats of systematic, algorithmic bias from invalid or flawed measurements. Considerable technological progress, careful foresight, and continuous scrutiny will be needed so that positive impacts of BMTs far outweigh the negative.”

Goldstone elaborated in an email to the *Observer*. “I went into this project wearing my research psychologist’s hat, with ‘kid in the candy store’ excitement about the prospects for better understanding psychology through the creative use of technology-enabled behavioral measurements,” he wrote. “While the articles vividly show the opportunities in this regard, I was surprised to find myself increasingly

troubled by the consequences of these measurements. The reviews point to many psychological dangers, for both individuals and society at large, in measurement systems that are being widely deployed and are rapidly affecting the course of our lives.” One result of these revelations, Goldstone added, is his “strong belief that psychologists need to play a more active role in critically assessing assessment itself. Rather than complacently using measurements as they currently exist, we need to be pushing for and creating better measurements that better capture the richness of human experience, and do not lead to negative consequences when they are used to guide people or policies.”

Here are brief summaries of each article (with links to those as they are published), along with further insights from a few of the authors.

**See the special issue, and all issues of this journal, at [psychologicalscience.org/publications/current\\_directions](https://psychologicalscience.org/publications/current_directions).**



Rob Goldstone, the editor of *Current Directions in Psychological Science*, commissioned the image he calls “The Modern Measure of Humanity” by illustrator Joe Lee, who was inspired by Leonardo da Vinci’s “Vitruvian Man.” “Da Vinci believed his Vitruvian Man represented the ideal measurements of bodily proportions,” Goldstone explained. “Today, we are surrounded by a staggering web of measurement devices constantly recording not only our body proportions, but our voices, writings, faces, choices, movements, and physiological responses.”

[Day-Long Mobile Audio Recordings Reveal Multi-Timescale Dynamics in Infant Vocal Productions](#)

## [and Auditory Experiences](#)

*Anne Warlaumont, Kunmi Sobowale (University of California, Los Angeles), and Caitlin Fausey (University of Oregon)*

The everyday sounds heard by human infants—their own babbling, adults singing lullabies, siblings squabbling, dogs barking, and so on—fluctuate over time. Infant-friendly wearable audio recorders allow researchers to capture and observe these sounds. Warlaumont and colleagues reviewed recent discoveries about how infants’ soundscapes are organized over the course of a day based on analyses designed to detect patterns at multiple timescales. The analyses revealed that everyday vocalizations are clustered hierarchically in time, vocal explorations are consistent with foraging dynamics (i.e., the patterns of infants’ exploration of different resources), and musical tunes are distributed such that some are much more available than others, which might help infants learn to categorize and generalize tunes. This approach—focusing on the multi-scale distributions of sounds heard and produced by infants—provides new insights on human communication development from a complex systems perspective.

## [Toward a “Standard Model” of Early Language Learning](#)

*George Kachergis, Virginia A. Marchman, and Michael C. Frank (Stanford University)*

Cognitive scientists have long attempted to understand early language learning and the mysteries of how speechless, wordless infants develop into children who use language expressively and creatively. Kachergis and colleagues see the emergence of a new synthesis of understanding based on theoretical and empirical work on vocabulary development. “Our goal is to present this synthesis as the beginnings of a ‘standard model,’” they write, “a baseline theory that is widely accepted in its outlines and that should guide future work, even if its assumptions still require rigorous evaluation.” Noting that the field of physics has a standard model that describes all known elementary particles along with three of the four known fundamental forces in the universe, the authors observe that psychology, “in general, has been criticized for lacking such formal theories that inform and drive empirical research.” They point to computational models, and “accumulator models” in particular, as potential sources of a unifying theory.

## **Ten Lessons About Infants’ Everyday Experiences**

*Kaya de Barbaro (University of Texas at Austin) and Caitlin Fausey (University of Oregon)*

Infants experience a diversity of activities, postures, objects, speakers, and more in a typical day. Their experiences are neither static over time nor interchangeable across infants. These and seven other lessons about infants’ everyday experiences emerged out of de Barbaro and Fausey’s review of recent research that used audio recorders, accelerometers, cameras, and other wearable sensors to quantify patterns of infants’ sensory histories. Wearable sensors “offer the unique opportunity to capture the experiences on which a lot of learning is hypothesized to depend,” the authors write. “The striking heterogeneity of experiences—there is no meaningfully ‘representative’ hour of a day, instance of a category, interaction context, or infant—inspires next steps in theory and practice that embrace the complex, dynamic, and multiple pathways of human development.”



“What’s really exciting is that wearables tell us things about development that are unknowable from other methods that yield data from only one task or only one short time period,” de Barbaro explained in an email to the *Observer*. “A really striking fact that this research prompts us to think more about is how infants’ experiences change from moment to moment and context to context. We’re excited to push theory in new directions that deal with this heterogeneity.”

## **Digital Life Data Filling the Clinical Whitespace**

*Glen Coppersmith (Qntfy)*

Coppersmith uses the term “digital life data” to describe the traces of our lives that are encoded in our routine interactions with technology, from social media posts to financial transactions. These data “can provide signals relevant to our psychology, well-being, and mental health,” he writes. “For example, GPS coordinates can indicate if we are staying home or moving about, and smartphone actigraphy can indicate whether we are resting or engaging in doomscrolling while we are stationary.” The author examines a few areas in which he believes these advances could significantly alter our approach to mental health and well-being, including greater personalization to improve adherence to and outcomes of clinical treatments and adaptive interventions calibrated to serve the right person at the right time.

## **Personality Change Through Digital Coaching Intervention**

*Matthias Allemand and Christopher Flückiger (University of Zurich)*

Personality traits—relatively enduring patterns of behaviors, thoughts, and feelings—are powerful predictors of a wide range of outcomes involving education, work, relationships, health, and well-being. They are generally considered rather immutable, but research suggests that many people want to change their personality. Can these traits be intentionally changed through psychological interventions? Moreover, should they? Allemand and Flückiger, writing from a perspective that assumes personality traits to be somewhat more dynamic and plastic than traditionally believed, explore the potential of digital applications to guide and support people in their desire to change personality and trigger change processes. They provide a rationale for nonclinical personality change interventions, draw from studies illustrating this emerging field of research, and explore future directions.

## **Digital Games as a Platform for Understanding Skill Acquisition From Novice to Expert**

*Tom Stafford and Nemanja Vaci (University of Sheffield)*

Digital gaming is a domain of profound skill development. Players’ digital traces create data tracking the development of expertise from novice to professional-level skill. Reviewing existing research on skill development using data from digital games, Stafford and Vaci show that gaming data allow novel analyses and make recommendations for future research into learning with games. They argue that existing work has not taken advantage of gaming data to understand skill acquisition, and that to fully do so will require computational accounts of complete game performance at the individual level, tied to a cognitive theory of skill and backed by experimental rather than observational studies.

[Lifespan Learning and Development and Its Implications for Workplace Training](#)

*Margaret Beier (Rice University)*

The psychology of aging tends to focus on age-related decline (e.g., in abilities, memory, and cognitive processing speed) rather than age-related growth and development. “Considering these declines, it is a wonder that most people are able to engage in problem solving, thinking, and learning beyond middle age,” writes Beier. Her research shows that older individuals can and do, in fact, learn, particularly when the content is aligned with their prior knowledge and interests.

Focusing on working-age people between 18 and 70 years old, Beier describes age-related changes in abilities and motivation that affect lifelong learning in the context of workplace training and development, highlighting the workplace as a central environment for continuous learning and the imperative for workers to continually update their skills to remain employed and employable. “I think what my research adds is a conceptualization of adult intellect that gives older people credit for knowledge,” she explained in an email to the *Observer*. “Psychology tends to think about intelligence as solving novel problems, and the type of intelligence that people possess as they age—i.e., knowledge and expertise—is not a focus. There is good reason for this focus on novel problem solving, but it’s not a complete view of human intelligence.”

For more on this topic, see “[A Lifetime of Learning](#)” in the November/December 2021 *Observer*.

### [Do Social Networking Sites Influence Well-Being? The Extended Active-Passive Model](#)

*Philippe Verduyn, Nino Gugushvili (Maastricht University), and Ethan Kross (University of Michigan)*

Do social media sites influence well-being? The answer depends on how the sites are used, according to the active-passive model of social networking site (SNS) use. It argues that using such sites to actively and positively interact with other people is good for well-being, whereas consuming SNS content passively has a negative impact.

Verduyn and colleagues “offer a more nuanced approach by illustrating that SNS are not inherently good or bad but that their consequences depend on how they are used (usage types) and by who uses them (user characteristics),” Verduyn explained via email. The authors propose an extended active-passive model of SNS, in which active use stimulates social capital and feelings of connectedness only when users engage in “warm” interactions with specific individuals, rather than merely posting status updates. Passive use of SNS, in turn, “only results in damaging social comparisons when consuming success (vs. failure) stories of other users, especially when the content is relevant to the evaluation of one’s self-concept.” SNS research, Verduyn wrote, “should move away from only assessing the amount of time spent on social network sites and instead focus on the interaction between usage types and user characteristics.”

### [Field Experiments on Social Media](#)

*Mohsen Mosleh (University of Exeter), Gordon Pennycook (University of Regina), and David Rand (Massachusetts Institute of Technology)*

Research using online behavioral data is often purely observational, which limits its ability to identify

causal relationships. Mosleh and colleagues review recent innovations in experimental approaches to studying online behavior, with a particular focus on research related to misinformation and political psychology. Their article explores “different approaches for doing experiments ‘in the wild’ on social media,” including hybrid field–lab studies, “rather than traditional survey experiments most psychologists do,” Rand explained via email. “This allows you to look at the effect of interventions on the online behavior of people who don’t know they are in an experiment, and who are making real decisions rather than hypothetical (e.g., about what content to share or whom to follow).” The authors review one experiment in which Twitter bot accounts sent an accuracy-priming message to users who had been sharing links to misinformation. This tactic was found to significantly increase the quality of news these users shared.

### **Psychological Measurement in the Information Age: Machine-Learned Computational Models**

*Sydney K. D’Mello (University of Colorado Boulder), Louis Tay (Purdue University), and Rosemary Southwell (University of Colorado Boulder)*

Could psychological measurement benefit from an information-age update based on real-world data and advances in sensing and computing? D’Mello and colleagues explored the emerging field of machine-learned computational models (MLCMs)—computer programs that learn from data, usually with human supervision. Providing examples from cognitive and affective science, neuroscience, education, organizational psychology, and personality and social psychology, they consider the accuracy and generalizability of MLCM-based measures, cautioning researchers to consider the underlying context when interpreting performance and making claims. They conclude that “in addition to known concerns of data privacy and security, the use of MLCMs entails a reconceptualization of fairness, bias, transparency (i.e., interpretability), and responsible use.”

### **[Integrating Insights About Human Movement Patterns From Digital Data Into Psychological Science](#)**

*Joanne Hinds, Olivia Brown, Laura Smith, Lukasz Piwek, Adam Joinson (University of Bath), and David Ellis (Lancaster University)*

Existing research largely uses data-driven modeling to detect patterns in people’s movements, but such approaches are often devoid of psychological theory and fail to capitalize on what movement data can convey about associated thoughts, feelings, attitudes, and behavior. Hinds and colleagues outline trends in current research and explore how psychological scientists might better address theoretical and methodological challenges. They argue that interdisciplinary research combining approaches from psychology and data science will enable better predictions about human movement patterns and could advance psychological theory.

“Movements are fundamental to everyday living,” Hinds wrote in an email to the *Observer*, noting examples ranging from workers’ everyday commutes to refugees’ mass migrations. “Modern technologies such as smartphones and wearable devices track people’s geographical coordinates via GPS, as well as psychical activity patterns such as speed of walking and rotation (via accelerometers and gyroscopes).” But more than identifying where people are, digital data can also “reveal rich socio-psychological insights about their behaviors,” she added, citing Bluetooth and GPS data indicative of loneliness among Catholics and Protestants as they traveled through public spaces in Belfast. “From a

scientific perspective, digital data relating to people's movements provides opportunities to test theories in new contexts (e.g., intergroup contact theory). However, it also raises ethical issues relating to privacy and surveillance. We discuss these opportunities and challenges and suggest ways that researchers can overcome them."

### [What's to Come of All This Tracking 'Who We Are'? The Intelligence Example](#)

*Wendy Johnson (University of Edinburgh)*

In theory, all this tracking of what we do and how well we do it should foster greater health and well-being, but clear empirical evidence supporting these goals is in short supply. Johnson cites the example of IQ testing, which for more than 100 years has been used to determine who gets access to social benefits ranging from greater educational opportunities to higher-paying occupations. Moreover, the individuals receiving these benefits often pass the ability to "test well" to their children, leading to the intergenerational transmission of the benefits as well. "What does this mean for our future?" Johnson asks. She points to Aldous Huxley's 1932 novel *Brave New World*, which depicted a dystopian future society based on selective breeding and predetermined "castes," as a cautionary tale.

In Huxley's world, "all this is imposed by design, but we're largely bringing it on ourselves," Johnson writes. Who is most likely to benefit from the onslaught of new algorithms measuring behavior? "Those with highest levels of what we measure as intelligence and its underlying genes."