Well-being at the Workplace

A multidisciplinary approach and scalable digital tools

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IN BRIEF

Many organizations have employee well-being programs, but even with these in place, mental health issues that need clinical intervention and/or counseling go undetected. Often help arrives only after the problem is very severe, or when it has resulted in adverse outcomes. Behavior, Business, and Social Sciences (BBSS) research at TCS supports proactive initiatives for associate well-being. We discuss here some elements that can enable realistic modeling of organizational agents and an easy to consume interface that can improve well-being among employees.

A 24-year-old man with chronic depression takes to drugs and alcohol unable to deal with stress at work; a 30-year-old woman ends her life because she is deep in debt due to multiple family responsibilities; a middle-aged telephone operator hangs himself in office in the middle of his work day because of multiple health issues. It is not uncommon to see such headlines in newspapers. To many of us, these may not appear to be strong enough reasons to hurt ourselves, or end life. What becomes apparent though is a need for greater awareness of mental well-being and support for those with mental health issues at the workplace.

Constant and rapid change often requires today's workforce to not only adapt to external unforeseen changes but also have sufficient psychological resources and capabilities to respond to change in an effective manner. Capabilities such as resilience, stress management, and sound decision-making are some of the often-cited employee-related strengths critical to an enterprise's success as well. The TCS R&I division has well-being as one of its main focus areas in the Behavior, Business, and Social Sciences (BBSS) research area. At BBSS, we use a multidisciplinary lens to understand states of well-being within the enterprise and to guide associates toward improved well-being.

TCS Research: Behavior, Business, and Social Sciences

Outcomes: Behavior sensing and analytics, evidence-based interventions, purposeful games, knowledge repository, well-being app

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Academic Partners: MIT, University of Toronto

Techniques Used: Data Science, Modeling and Simulation, Behavioral Research Methods, Game Design Research

Industries Benefited: Life sciences, Healthcare, Pharma

Patent: 3

Papers: 8

Need for Multi-disciplinary Approaches to Well-being

Many organizations have employee assistance programs, but even with these mechanisms in place, many problems and challenges that need urgent clinical and/or counseling attention go undetected or reach the employee assistance program only after the problem is very severe and has resulted in adverse outcomes such as self-harm or suicide. This is due to several factors, ranging from the stigma associated with mental health problems, privacy concerns, and the lack of mental health awareness, to name a few.

Given the sheer scale of the problem of mental illness incidence worldwide, and the criticality of its management for the individual, enterprise, and society as a whole, there has been a sustained interest in the use of digital technologies to develop more scalable solutions for mental health management. Emergence of areas such as telepsychiatry[1], digital mental health[2], and digital therapeutics[3], reflects the growing application of technologies in the field of mental health. While there have been significant strides made in the development of these technologies for mental health, concerns regarding robustness, scalability, and evidence-driven technologies continue to dominate the field[4].

1 https://www.psychiatry.org/patients-families/what-is-telepsychiatry

2 https://psycnet.apa.org/fulltext/2017-39812-001.html

3 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6393746/

4 https://www.weforum.org/agenda/2019/01/power-digital-tools-transform-mental-health-care-depression-anxiety/

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Digital Solutions for Well-being

Building a scalable digital solution which can help address issues such as early identification of burnout, stress detection, and management and prevention of self-harm at the workplace not only demands expertise in the behavioral sciences, but also in related areas (e.g. workplace norms, HR policies) and in areas such as image recognition, voice analysis, big data management, and analytics, among others. The solution has to have several components such as:

- A knowledge base that supports behavior modeling related specifically to the workplace

- Image and voice recognition algorithms that can detect anomalies in the subject

- A platform that can fuse data from various sources and anchor the solution

- An engaging mobile app that serves as a companion and confidant to the user

- A robust measurement and intervention system for enhancing well-being in the enterprise

BBSS research has focused on each of these components and we would like to briefly describe on them here.

A Knowledge Repository

The need for repositories as sources of information in a domain has been a critical requirement across scientific disciplines. There are knowledge repositories related to behavioral sciences, but the focus here must be on:

A structured and usable repository amenable to computational behavioral modeling, synthesis of knowledge, generating evidence, identifying and generating new areas for research.

The repository has to be a structured entity, such as a set of tables in a well-recognized standard entity such as a relational database management system (RDBMS). This is to facilitate both the entry/modification of information into the repository as well as its querying to obtain its contents. Note that querying and consumption of the content should be possible both by a human or a program.

The creation of a minable repository of a vast area such as human behavior requires many steps such as:

1. Creating a corpus of papers in the behavioral sciences domain

2. Identifying relevant papers using a low-cost multiclass classifier

3. Identifying sections in each relevant paper that have empirical results of interest using intra paper classifiers. (This second-level classifier is built because techniques such as information extraction in natural language processing are compute-intensive). The process splits as below:

3.1 Information tagging and extraction techniques to identify behavioral variables, the relation terms, the strength and the confidence of the relation, as well as other information considered relevant from text, using a text relation miner;

3.2 A table extractor to process the tables (if any) in the paper to extract quantitative empirical findings

4. Combining the information obtained through the relation miner and table extractor to put together a complete record of an empirical finding using an integrator

5. Verification of the extracted knowledge by domain experts, after which validated knowledge is now moved to the main behavior repository

Several challenges have to be overcome in creating the repository: lack of domain experts as well as varied structures and formats of the reports and tables. There is also the issue of the lack of definitive solutions for processing tricky areas of natural language and written text. A separate machinery may be required to create resources for activities such as correcting error terms, mapping synonyms to each other, expanding acronyms and abbreviations, identifying other semantic relations between terms such as hypernymy and hyponymy, adding context to a term in a particular usage so that there is a differentiation between different uses of the same term, among others.

Modeling Realistic Organizational Agents

One of the goals of the development of the Behavioral Relations Repository is to demonstrate the use of hypotheses from behavioral and management sciences in modeling behavior across the organization. Agent-based

modeling and simulation (ABMS) is amenable to the study of a wide range of behavioral dynamics in a given context. ABMS has been traditionally used in the study of complex systems, but its applications to organizational psychology have been sparse. ABMS has been applied to the study of macro behavior in the realms of social psychology; however, its use in studying the micro-foundations of behavior has been limited. To bridge this gap, fine-grained agent-based models can be used to develop realistic models of behavior anchored in the domain of organizational behavior.

A Well-being App

There are many mobile apps that are meant to help with measuring and improving one's well-being, but many of them are meant for those who are already seeking help or already know they have a problem. Today, it is possible to sense emotions through voice, facial expressions, and activity. A mobile phone today can sense so much about its owner: acts of physical activity, tone of voice, facial expressions, and lifestyle behaviors (sleeping/shopping/ spending/interacting), among others, that it becomes a source of information about a person's well-being. Within the limits of GDPR, much of this data can be analyzed and alerts may be provided to the subject/caregiver on anomalies from usage patterns within the well-being app. If the app is further gamified and endears itself to the user, both accurate data collection and intervention may be possible.

> Fine-grained agent-based models can be used to develop realistic models of behavior anchored in the domain of organizational behavior

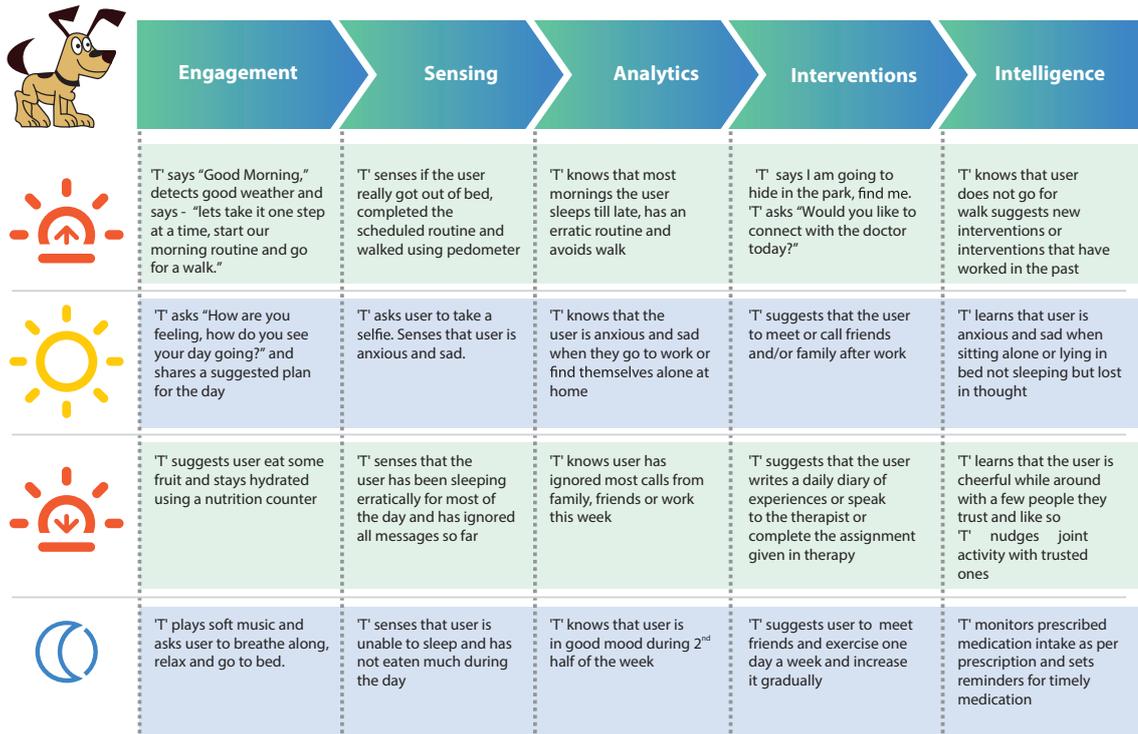|	Engagement	Sensing	Analytics	Interventions	Intelligence
(morning)	'T' says "Good Morning," detects good weather and says - "lets take it one step at a time, start our morning routine and go for a walk."	'T' senses if the user really got out of bed, completed the scheduled routine and walked using pedometer	'T' knows that most mornings the user sleeps till late, has an erratic routine and avoids walk	'T' says I am going to hide in the park, find me. 'T' asks "Would you like to connect with the doctor today?"	'T' knows that user does not go for walk suggests new interventions or interventions that have worked in the past
(day)	'T' asks "How are you feeling, how do you see your day going?" and shares a suggested plan for the day	'T' asks user to take a selfie. Senses that user is anxious and sad.	'T' knows that the user is anxious and sad when they go to work or find themselves alone at home	'T' suggests that the user to meet or call friends and/or family after work	'T' learns that user is anxious and sad when sitting alone or lying in bed not sleeping but lost in thought
(evening)	'T' suggests user eat some fruit and stays hydrated using a nutrition counter	'T' senses that the user has been sleeping erratically for most of the day and has ignored all messages so far	'T' knows user has ignored most calls from family, friends or work this week	'T' suggests that the user writes a daily diary of experiences or speak to the therapist or complete the assignment given in therapy	'T' learns that the user is cheerful while around with a few people they trust and like so 'T' nudges joint activity with trusted ones
(night)	'T' plays soft music and asks user to breathe along, relax and go to bed.	'T' senses that user is unable to sleep and has not eaten much during the day	'T' knows that user is in good mood during 2nd half of the week	'T' suggests user to meet friends and exercise one day a week and increase it gradually	'T' monitors prescribed medication intake as per prescription and sets reminders for timely medication

Figure 1: *'T' for Depression Sensing and Intervention – a sample case*

Advancements in NLP and related areas have helped evolve novel approaches in addressing challenges in creating knowledge repositories

An Anchoring Platform

Central to a digital solution is a platform for multimodal behavioral data capture through numerous data capture devices, sensors, and secondary data sources; behavioral knowledge mining from multiple sources; behavioral analytics; behavioral knowledge delivery to various simulators, games, and reasoners. The platform acts as the hub for the entire ecosystem of tools and applications. It must have the Behavior Knowledge Repository as its source of knowledge. The platform must have analytics capabilities such as a personal well-being dashboard, population level well-being analytics, and a pattern discovery module. Other capabilities include a manual intervention module and a behavior study design wizard in addition to the behavior relations repository and an interventions repository. In keeping with current GDPR policies, the platform must be compliant with privacy and other aspects outlined in standard GDPR practices that are in effect today.

The Road Ahead

In building the digital solution with the components mentioned above, we have had a taste of success (View Box). The knowledge repository that we are building will keep growing as behavioral science is a vast area encompassing many domains such as psychology, cognitive science, and sociology, among others, and new knowledge is added constantly across all areas of science. Challenges in building the knowledge repository include the reproducibility debate, which focuses attention on the need for replicating evidence to test for its robustness and generalizability

across different settings.

Advancements in NLP and related areas have helped evolve novel approaches in addressing these challenges in creating such repositories, and work on these aspects is underway at BBSS. The serendipitous value we have discovered is that many other areas of research are keen on learning our techniques in building knowledge repositories in other domains as well.

Both the digital platform and the app will gain new features and usage through our continuing field trials. We envision these tools being used in enhancing employee well-being as well as other contexts where human behavior measurement and change is of importance. This could range from problems in the space of change management, competency management, learning, and many more.

Digital Companion for Well-being

TCS endeavors to be proactive in employee support initiatives. Being a technology company spearheading digital transformations for leading businesses, it uses digital tools for several employee initiatives such as fitness, marathon running, accessibility, and social responsibility. As mental well-being is a top concern for TCS HR, it has approached the BBSS research team for various studies, notably in workplace stress and productivity among support service teams; individual productivity and well-being; and the link between perceived supervisory support and subjective and objective performance measures, among others.

We were asked to build a scalable solution to foster mental well-being. The solution has come from our research in BBSS and is anchored on a platform called Beacon. It draws knowledge from the domain repository we built, it analyses facial expressions and voice anomalies of the user, it holds the mobile app we call 'T' ('T' is an internal identifier), and it has scoring mechanisms and intervention protocols. We would like to highlight the consumer end of the solution 'T' here.

'T' is a digital companion based on the concept of a pet dog . The 1990s saw the rise of virtual pets. Since a large percentage of TCSers are millennials, the idea of a virtual pet is an accepted concept. Our Serious Games research team created the character and tested it with the target audience who said virtual pets are fun to engage with, and valued the chance to share emotions without being judged.

'T' uses the latest techniques in the area of purposeful games. It is data privacy-conscious and built upon numerous sensing technologies to measure well-being and assist people in adopting behavior changes that help them stay in the positive end of
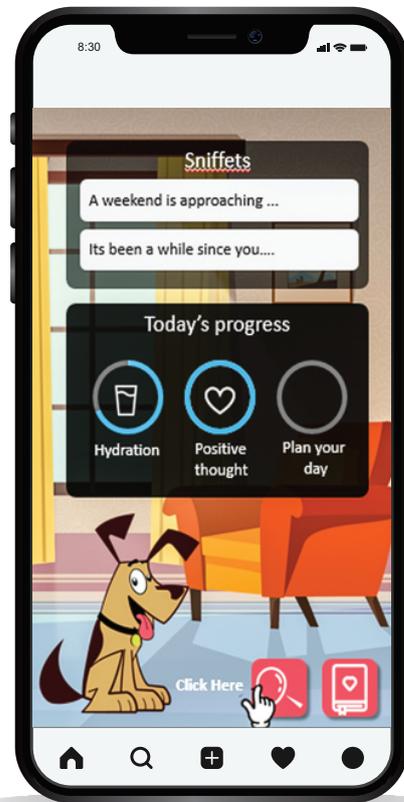
Figure 2: *'T' Landing Page*

the well-being spectrum. We have carried out initial user pilots with 'T' and are currently refining 'T' to incorporate these inputs as well as carry out larger pilots across the enterprise. In terms of physical sensing, 'T' capabilities include emotion detection with speech, text, and camera images as inputs. Other capabilities include laughter and blow detection, physical activity sensing, and heart rate sensing.

Scenarios for 'T

'T' is currently envisioned as a Digital Companion App for well-being at work including measurements and interventions targeted at workplace stress management. Other behavioral change interventions that can be enabled by 'T' include a more balanced lifestyle, improved relationships, enhanced motivation,

and other well-being behaviors of interest. In addition, 'T' is also amenable for applications in other scenarios such as managing depression. Figure 1 illustrates this application. As shown in Figure 1, 'T's sensing, measurement, and intervention capabilities enable an individual living with depression to track his/her moods, activities, and lifestyle over time.

As a companion for therapy for individuals with depression, 'T' presents a promising scenario that is being explored with our partners in healthcare and insurance contexts as well as with clinicians working with patients suffering from depression. Many patients require a combination of both medication and therapy to manage their symptoms and to stay productive. 'T's capabilities potentially allow for the therapeutic interventions to be delivered to the user at prescribed times as well as be sensed/tracked for medication and therapy follow-ups with the clinicians. Given that the doctor's appointments are likely to be short and sporadic, 'T'allows the patient, clinician, and the caregiver to manage the treatment regimen longitudinally. Once we have a more robust version of 'T' ready for the workplace well-being context mentioned above, we plan to explore 'T's applications for depression management (Figure 2).

Mayuri Duggirala

Mayuri Duggirala is a senior scientist with the Behavior, Business, and Social Sciences Research team at TCS R&I. At BBSS, her work focuses on the applications of behavioral science research to various problems of interest to the organization and the larger stakeholder ecosystem. In particular, Mayuri works on examining well-being and its many facets and areas of impact using a technology-driven approach. Her work in BBS research also focuses on applications of fine grained behavioral modeling and simulation, technology-enabled behavioral measurement and change, serious games and service design for behavior change. Her recent work spans well-being and related areas such as stress, productivity, engagement, employee satisfaction, etc.

Mayuri holds a Ph.D. (Management) from the Indian Institute of Technology Madras with an academic background in applied psychology and organizational behavior. She has also worked in the areas of technology-mediated learning, healthcare services quality, and IT-enabled services research, technology adoption, learning etc.

Sachin Patel

Sachin Patel is a Senior Scientist with Behavior, Business and Social Sciences Research Team at TCS R&I. His research interest is in behavior sensing and its applications in personal informatics/quantified self systems. He had led multiple innovation projects from ideation to deployment. In his previous stint as a software professional he had acquired extensive experience in managing and delivering enterprise software projects.

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