RESEARCH STATEMENT

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Expertise: Human-Centered AI, Data Science, Mental Health & Wellbeing, Ubiquitous Computing

I am a postdoctoral fellow at Stanford University's Institute for Human-Centered Artificial Intelligence (HAI), developing innovative AI systems to transform mental health research and interventions. **My work combines AI technologies with ubiquitous computing to create next-generation solutions for understanding and supporting mental health and wellbeing.**

Working at the intersection of AI, Digital Health, and Human-Computer Interaction, I leverage data from smartphones and wearables to develop advanced AI models that can detect early signs of mental health issues and deliver personalized interventions. My research spans both clinical and non-clinical settings, from healthcare tools that monitor and support individuals with mental health challenges to AI-driven systems that enhance student wellbeing and workplace mental health. I employ diverse AI and machine learning approaches, combined with longitudinal studies, to examine human behavior in real-world contexts (Figure 1):

1. **Large-scale Longitudinal Studies:** I conduct extensive behavioral research using ubiquitous technology, including the longest-running mobile sensing study to date - a five-year investigation tracking college students' behavioral patterns and mental health trajectories [6].
2. **Advanced AI Models:** I develop novel AI systems for mental health detection using passive sensing data, including unique approaches like depression detection through naturalistic smartphone images [3].
3. **AI-Powered Interventions:** I create innovative interventions using Large Language Models (LLMs) and context-aware behavioral sensing systems, spanning from mental health support for clinical populations [11] to AI-driven platforms promoting student and workplace wellbeing [12, 13, 14].

My research has led to 13 first-author papers and over 30 publications in prestigious venues like ACM UbiComp, CHI, and CSCW. My work has earned notable recognition, including UbiComp's Distinguished Paper Award (top 1%), the Neukom Outstanding Graduate Research Award at Dartmouth College, and coverage in major media outlets like the Washington Post and Financial Times. With an h-index of 15 and over 1500 citations, my research has established strong collaborations across academia (Stanford, MIT, Georgia Tech) and industry (Microsoft Research). These interdisciplinary partnerships, spanning psychology, brain sciences, and engineering, continue to enhance the reach and impact of my approaches to mental health.

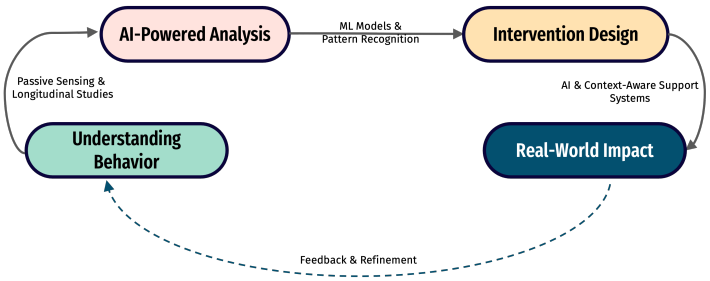

Figure 1: AI-Driven Approach to Mental Health Research. A systematic approach to advancing mental health support through AI and ubiquitous computing. My research begins with understanding human behavior through passive sensing and longitudinal studies, progresses through AI-powered analysis of behavioral patterns, and leads to the design of intelligent interventions for real-world applications across clinical, academic, and professional settings. The feedback loop enables continuous refinement based on observed outcomes and user experiences.

Capturing Life as it Happens with Behavioral Sensing Technology

My work starts with a simple yet powerful idea: to understand people, we need to observe them in their natural environments. I use everyday technology - smartphones, wearables, and the like - to capture real-world behavior as it happens. This approach is key because it gives us genuine insights into how people actually live, work, and interact. I have applied this method across a diverse range of groups – professionals in their workplace, trying to understand the ebb and flow of stress and productivity; students as they navigate the ups and downs of college life; and, clinical populations, examining how their daily behaviors relate to their health outcomes.

In the workplace, my research reveals how subtle behavioral patterns can indicate broader trends in employee wellbeing and performance [2, 5, 9, 10]. For instance, I have found that high performers exhibit more consistent work schedules and lower stress levels during commutes, suggesting that the structure of daily routines may significantly impact professional success [9, 10]. Moreover, my work on job promotions uncovered gender disparities in stress responses, highlighting the need for tailored support systems in professional environments [2]. One thing I am particularly interested in is how people handle big life changes. The transition to college is a great example - it is a time when students face all sorts of new challenges. To this end, my research on first-generation students reveals how socioeconomic factors and support networks influence behavior and mental health [4]. Despite facing unique challenges, these students demonstrate remarkable resilience, adapting their behaviors over time to improve their mental health outcomes. This finding underscores the importance of considering diverse backgrounds when developing support systems in educational settings.

More recently, I have been looking at how the COVID-19 pandemic has shaken up our routines and affected mental health across different groups. Through a longitudinal study of over 200 Dartmouth undergraduates, I tracked significant behavioral shifts, including a 60% decrease in physical activity and a 15% increase in phone usage [1]. Crucially, this research identified two distinct groups of students based on their behavioral changes and mental health responses, illuminating the diverse ways individuals cope with major disruptions[1]. This work provides insights into crisis response and also offers a framework for understanding long-term adaptation to stressful events. A key strength of my approach is the integration of long-term data collection with variety of analysis techniques. My recent five-year longitudinal study of college students exemplifies this, examining mental health fluctuations throughout the entire college journey [6]. By combining quantitative data from mobile sensing with qualitative insights from interviews, this research provides a comprehensive view of how students navigate the complex landscape of higher education, including the lasting impacts of events like the COVID-19. Furthermore, I led the public release effort of the de-identified dataset to advance research in this field[2]. This rich dataset offers a unique opportunity for in-depth exploration of mental health and behavioral patterns in college students using mobile sensing and self-reports. By carefully documenting behavioral patterns during different life events - from students during finals to professionals handling critical incidents - **I gather insights that inform the design of practical AI based early detection and intervention systems**.

Predictive Modeling of Mental Health Outcomes using Machine Learning

If we can use the wealth of data from ubiquitous technologies to understand behavior better, could not we also use it to automatically assess mental health and other psychological attributes?

This question drives the next phase of my research. I am exploring ways to develop automated systems for early detection of mental health issues. The potential benefits are twofold: we could reduce our reliance on self-reports, which are often intrusive and prone to biases or memory lapses, and we could make mental health care more accessible and timely. By tapping into passive data collection, we might create a more continuous and objective picture of someone's mental state, complementing traditional methods and potentially extending mental health support to those who need it most.

I have developed numerous predictive models using passive sensing data for various outcomes, from depression levels [4] and COVID concern [1] to workplace performance [10, 2]. A particularly innovative study, *MoodCapture*, investigates using opportunistic mobile sensing to detect depression [3]. We capture non-performative images of individuals with major depressive disorder using smartphone front cameras as they complete depression surveys, aiming to uncover depression signals in these naturalistic images[3]. We obtain a promising result highlighting the potential of mobile sensing in providing mental health insights in everyday settings.

However, as my research has progressed, I have encountered the complex challenges of generalizing these behavioral models across diverse datasets. Mental health's complexity, defined by subjective diagnoses and fluctuating symptoms, makes prediction based solely on ubiquitous computing a challenging task. I have come to appreciate the nuanced layers of behavioral prediction. There is a spectrum of predictability in human behavior and mental states. On one end, we have phenomena like smartphone overuse or digital addiction, which are relatively straightforward to predict because the relevant behaviors are largely captured within the device itself. On the other end, we have complex conditions like depression, which are influenced by a myriad of factors, many of which exist beyond the reach of our phones and wearables.

This realization has led me to examine the generalizability of behavioral models across diverse datasets. I am finding that while our models may perform well in specific contexts, their applicability across different populations or environments often falls short of our expectations. In a UbiComp study, which won the distinguished paper award (top 1%), my colleagues and I combined datasets from two universities to test the generalizability of depression prediction models [7]. Our findings revealed the limited applicability of current approaches, achieving only 55.2% balanced accuracy. Similarly, in another study on speech-based diaries for detecting suicidal ideation, we found poor cross-dataset generalizability in current methods [8]. Despite these challenges, I believe in the value of both generalizable and specialized models. Even if we could early detect mental health issues for a specific population, say Stanford students, it would be a significant achievement. **Moving forward, I aim to combine multiple signals, including self-reports and AI-based approaches, to revolutionize mental health support through more accurate and accessible predictive systems**.

Transforming Behavior Through AI-Driven Systems

My next line of research focuses on leveraging ubiquitous technologies and AI, particularly LLMs, to create personalized interventions that actively promote positive behavioral changes. This work represents a significant shift from merely assessing and predicting mental health to actively improving it. As with my prior studies, my interventional studies too span diverse populations, including individuals with serious mental illnesses (SMI), college students, and information workers. Across these groups, I'm exploring how AI-driven, context-aware technologies can be integrated into daily life to support mental health and wellbeing. My goal here is to close the loop between understanding, assessing, and actively

[1] This study was featured in the Washington Post.
[2] College Experience Dataset is publicly available on Kaggle.
[3] This study received considerable media coverage from popular press.

improving mental health.

In collaboration with UCSD's Center for Mental Health Technology, we developed a novel, context-aware intervention that combines in-person Cognitive Behavioral Therapy (CBT) with mobile CBT interventions [11]. This approach addresses social isolation in individuals with SMI by utilizing behavioral sensing data to trigger context-specific therapeutic activities. For instance, when a participant is home and alone, the app challenges their negative beliefs about social situations. Similarly, after a social interaction, it helps them savor positive aspects and challenges negative thoughts about future interactions. Our 24-week clinical trial yielded promising results, including a clinically significant increase in social interactions and improvements in multiple other outcomes. Based on these encouraging findings, we have submitted a proposal for a follow-up randomized controlled trial. Extending interventions to non-clinical populations, I designed *MindScape* [12, 14], a context-aware journaling app for Dartmouth students. This app **integrates behavioral sensing with LLMs to generate personalized journaling prompts based on factors like physical activity and sleep patterns**. An 8-week study revealed statistically significant increases in positive affect and decreases in negative affect, loneliness, anxiety, and depression among participants. I further explored the application of LLMs in improving the wellbeing and productivity of information workers. This project involved developing a GPT-4-powered tool[4] that used digital activity data to enhance workers' self-awareness and help them explore their workplace behavior [13].

These studies showcase the evolution of my research: from understanding behavior through AI-driven analysis to developing predictive models, and finally, to creating intelligent interventions that actively promote positive change. This comprehensive approach harnesses AI and ubiquitous computing to transform how we understand, assess, and improve human behavior.

Future Research Agenda

As a postdoctoral fellow at Stanford's Institute for Human-Centered Artificial Intelligence, I am actively laying the groundwork for my future research vision: advancing the intersection of AI and mental health research. Building on my expertise in mobile sensing and contextual interventions, I am developing and will continue to advance next-generation AI systems that can understand and respond to human behavior in real-time, now enhanced by the capabilities of LLMs.

A key direction of my future research explores how AI can revolutionize personalized mental health support. For instance, I am developing advanced AI systems that combine behavioral sensing with LLMs to deliver contextually-aware interventions. While I have demonstrated this approach through AI-powered journaling that generates personalized prompts (through prompt engineering), I am now exploring more on embedding behavioral context in AI systems. These innovations will enable more interactive and adaptive mental health support systems. I am already putting these ideas into practice through multiple projects at Stanford. As a Co-PI on a Stanford HAI seed grant application, I am developing AI agents to support adolescent identity formation in Bay Area community schools. I am also partnering with Flourish Science as part of Stanford Impact Labs Seed Grant to develop AI-based interventions for community college student mental health. This collaboration involves field experiments testing various AI-driven approaches, from contextual emotional regulation support to virtual mentoring systems, with the goal of identifying scalable solutions to the college mental health crisis.

Building on my research in predictive modeling, I plan to balance prediction with holistic understanding of mental health through digital means. I aim to integrate exploratory analyses with prediction approaches to uncover complex behavioral patterns in understudied areas, such as the long-term impact of digital interventions and the role of social support networks in mental health outcomes. Beyond support, I will explore proactive mental health promotion through AI systems that anticipate and prevent potential challenges before they arise. This includes developing contextually-aware systems that can identify opportunities for positive behavior change and deliver personalized interventions at opportune moments. In addition, another crucial aspect of my future work involves strengthening the bridge between digital innovations and traditional healthcare delivery. I plan to develop AI-based decision support tools that augment clinical expertise, helping therapists and healthcare providers make more informed decisions through real-time behavioral insights and intervention recommendations. These collaborative healthcare models will be tested across diverse populations - from clinical populations managing serious mental illnesses to students navigating academic pressures and professionals facing workplace challenges. Through this comprehensive approach spanning clinical, academic, and professional contexts, my research will continue to advance our understanding of how AI and ubiquitous computing can enhance mental health care delivery and promote overall wellbeing.

My long term future goal is to advance our understanding of mental health and wellbeing through digital means while addressing the challenges and ethical implications. To support this research agenda, I plan to pursue funding from NIH (particularly NIMH R21 and R01 programs), NSF CAREER, and NSF Human-Centered Computing. These funding mechanisms will enable me to expand my work in AI-driven mental health interventions while fostering collaborations across disciplines.

[4]This work was also highlighted as a notable research on Microsoft Research Blog.

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