From Research to Reality: An exclusive interview with Sara Močnik, Medical Doctor

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In this conversation, Sara Močnik, a researcher at University of Maribor, Faculty of Electrical Engineering and Computer Science, partner in SMILE project, discussed her recent publication and its implications for SMILE project.

Sara Močnik is a medical doctor and child and adolescent psychiatry resident at the Unit for Paediatric and Adolescent Psychiatry, University Medical Centre Maribor, Slovenia. She is also a researcher at the Laboratory for Digital Signal Processing, University of Maribor, and a PhD student at the Faculty of Medicine, University of Maribor. Her doctoral research focuses on identifying digital biomarkers for borderline personality disorder using artificial intelligence.

The study titled "*Beyond clinical observations: a scoping review of AI-detectable observable cues in borderline personality disorder*", was authored by Sara Močnik, Urška Smrke, Izidor Mlakar, Grega Močnik, Hojka Gregorič Kumperščak, and Nejc Plohl, and published in *Frontiers in Psychiatry*, explores how AI can identify observable cues in Borderline Personality Disorder (BPD), offering new avenues for digital mental health interventions. [https://doi.org/10.3389/fpsyt.2024.1345916]

To begin with, could you explain what digital biomarkers are and how they can be used to assess and support mental health?

Digital biomarkers are objective, measurable data collected through digital devices like smartphones, wearables, and health apps. They capture physiological signals (e.g., heart rate, sleep patterns, activity levels) and behavioral patterns (e.g., speech, activity fluctuations, or digital interactions). These biomarkers offer continuous, real-time insights into an individual's emotional and cognitive state.

In mental health, digital biomarkers are used to monitor and assess well-being, detect early signs of conditions like anxiety or depression, and tailor personalized interventions. For example, changes in app usage or communication patterns can indicate stress, allowing timely support. By integrating artificial intelligence and machine learning, digital biomarkers enhance diagnosis, tracking, and treatment, bridging the gap between traditional assessments and proactive, real-time care, and making mental health support more accessible and personalized.

What do you see as the most significant barrier to implementing digital biomarkers in broader mental health applications, and how might future research overcome these challenges?

The key barrier to implementing digital biomarkers in mental health is the lack of validation, standardization, and integration into clinical practice. This is particularly evident in borderline personality disorder (BPD), where traditional biomarkers like EEG, MAO levels, and genetic studies have yielded inconsistent and clinically limited results over decades of research.

Digital biomarkers offer a promising alternative by providing dynamic, real-time insights into behavioral and physiological patterns, addressing the heterogeneity of BPD. However, challenges include standardizing data collection, ensuring privacy, and integrating findings into clinical workflows.

Future research must focus on validating digital biomarkers across diverse populations, developing ethical frameworks for data use, and integrating these tools into practice. By overcoming these challenges, digital biomarkers can enable more precise and personalized mental health care.

How are digital biomarkers integrated into SMILE's digital tools to improve mental health support for young people?

Currently, SMILE's tools do not use digital biomarkers, as there are no known validated, clinically useful biomarkers in psychiatric diseases. However, SMILE's tools, such as the Serious Game and Companion Mobile App, collect valuable data on behavioural patterns, mood responses, and interactions, which serve as a foundation for detecting and researching potential digital biomarkers. By analyzing this data, we hope to identify trends that could be relevant to mental health conditions, possibly leading to the development of validated biomarkers. These insights could then be integrated into SMILE's Decision Support System to provide evidence-based guidance to practitioners. Through this approach, SMILE could contribute to both advancing mental health support for young people and the broader goal of developing robust digital biomarkers for psychiatric care.

Your research underlines the importance of language patterns. Could SMILE's Companion App integrate similar features to track or assess language usage in real-time? How might this improve emotional awareness and early intervention for young users?

Yes, SMILE's Companion Mobile App could potentially integrate features to track and assess language usage in real-time, such as analyzing text responses to daily mood questions or video diary entries. By incorporating natural language processing (NLP)

algorithms, the app could detect changes in language patterns, such as shifts in tone, sentiment, or the use of specific emotional or cognitive terms. These shifts could serve as early indicators of emotional distress, enabling both the user and practitioners to gain valuable insights into the user's mental state. Real-time analysis would allow for early identification of negative emotional trends, such as increased anxiety or depressive symptoms, thus enabling timely interventions. By improving emotional awareness through continuous monitoring of language patterns, the app could empower young users to better understand and express their feelings. Additionally, it could provide practitioners with objective data, supporting more personalized and proactive care, ultimately enhancing the overall effectiveness of mental health support for young people.

In your study, you mentioned limitations like mostly female participants and inconsistent methods. How do you think the SMILE project, with its ongoing Living Labs in different countries, can address these issues to create more inclusive solutions?

The SMILE project, with its ongoing Living Labs in different countries, offers a promising approach to addressing many of the limitations observed in previous research on BPD and other mental health conditions. By incorporating diverse populations from multiple regions, SMILE can ensure broader gender and demographic representation, overcoming the bias towards female participants seen in past studies. These Living Labs provide an opportunity to capture data from a wider range of individuals across various age groups, genders, and cultural backgrounds, allowing for more inclusive and generalizable findings. Furthermore, the Living Labs can implement consistent and standardized methods for data collection, helping to reduce the methodological inconsistencies that have hindered previous research. The use of SMILE's digital tools, such as the Companion App and Decision Support System, also enables continuous, real-time monitoring of emotional and behavioral patterns, which may help mitigate diagnostic biases or missed diagnoses, particularly in populations like males who are often underrepresented in early mental health interventions.

In your study, you mention 'social smiles.' Could you explain what social smiles are and what role they play in understanding emotional expressions and social interactions?

Social smiles refer to smiles that individuals with BPD display during social interactions, even when they are experiencing negative emotions like disgust or contempt. These smiles are often used in social contexts to signal friendliness, cooperation, or to align with social norms, even if the underlying emotional state is not positive. In individuals with BPD, this can suggest a discrepancy between their true emotional experience and the social mask they present. Social smiles play a

significant role in understanding emotional expressions because they can sometimes mask internal distress, making it harder to accurately assess how someone is feeling. By examining these smiles, we gain insight into the complexity of emotional regulation in BPD, where the individual may still seek connection or acceptance despite their emotional challenges. This highlights the need for more nuanced diagnostic and therapeutic approaches that consider both visible emotional expressions and the internal experiences they may be concealing.

Thank you!