



# The Power of Large Behavior Models in Healthcare Consumer Engagement



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Lirio has developed the world’s first Large Behavior Model (LBM) for healthcare, pioneering the bridge between behavioral science and artificial intelligence (AI) to significantly enhance health outcomes through hyper-personalized recommendations and communications.

In contrast to Large Language Models (LLMs) that are structured around linguistic patterns, Lirio’s LBM is specifically designed to capture health-related behavioral patterns.

This model closely observes individuals’ health journeys, understands their behaviors within their unique contexts, draws from past experiences, and can be used to predict likely future actions and potential health impacts.

These behavioral insights make it possible to discern the steps likely to be most effective in a person’s specific health journey to change behaviors and, consequently, outcomes, in meaningful ways. This unique focus offers something distinctly valuable and innovative to the healthcare industry.

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## Uniting AI & Behavioral Science to Empower Healthier Populations

AI solutions are on the rise throughout healthcare – and both payers and health systems aim to deploy these technologies to help increase meaningful engagement with members and patients.

Large language models have significantly contributed to recent advances in generative AI. While LLMs can support patient engagement efforts, they fall short in helping organizations effectively move people to take specific actions that lead to better health outcomes.

The reason is simple: language is only part of the patient and member engagement equation. Understanding human behavior is the rest. That's where Lirio's LBM comes in.

Healthcare organizations must go beyond automated messages for the people they seek to engage. Each person's health journey must be orchestrated to account for individual differences and optimize health outcomes specific to their unique challenges and barriers to better health.

**The fusion of Behavioral Science and AI makes this possible, ushering in a new era of hyper-personalized health consumer experiences.**

## Beyond Large Language Models

A large language model is an example of a foundation model, which is any model built on a large amount of data in a specific domain to capture generally predictive patterns for solving many different tasks in said domain.

This paradigm often allows for much more data to be leveraged to capture these more globally useful patterns while also requiring adaptation of the foundation model to optimize its use for a given application.

While LLMs are the most recognizable type of foundation model, they are just a subset of these technologies. Just like any other application of machine learning (ML), the algorithmic structures, data, patterns, and objectives must be aligned with the model's intended use to achieve success.

LLMs were not built with suitable structures and trained with the correct data and objectives to support behavior change in healthcare. Thus, they will never be as good at achieving such a goal as a model built specifically for that purpose. In other words, LLMs were constructed to understand linguistic contexts and, for example, facilitate the generation of language that fits naturally within said contexts.

## Behind the Science: What Makes Up an LBM

Let's go under the hood to delve into the core components of Lirio's LBM: the combination of behavioral science advancements with cutting-edge ML and AI innovations, working in tandem to deliver high-impact outcomes.

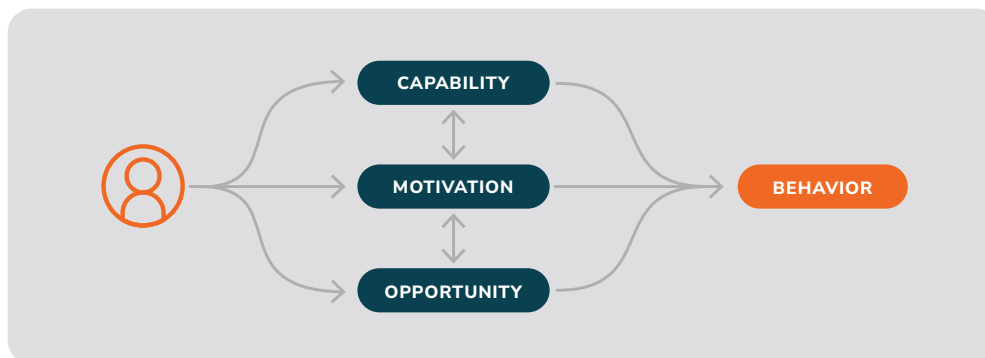
### Behavioral Design

Behavioral design infuses the creation of interventions that help change behaviors with evidence-based theories of human behavior. The marriage of behavioral science and human-centered design techniques makes it possible to design engaging and compelling avenues that support people in their health journeys.

Lirio's approach to behavioral design includes identifying the target behaviors that align with expert clinical recommendations and patient needs and the factors that promote or prevent those behaviors.

These factors, known as determinants, may include:

- capability to perform the behavior
- physical and social opportunity
- mental models
- motivations for action



Precision nudges help close the gap between people and behaviors by addressing barriers related to capability, opportunity, and motivation.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6(1), 42. doi:10.1186/1748-5908-6-42

We then apply specific behavior change techniques (BCTs) – linked by empirical evidence to an underlying mechanism of action – to each determinant. By building the right behavioral ingredients into the LBM and personalizing their delivery for each person, Lirio helps health systems and payers achieve meaningful outcomes for populations and individuals.

The Lirio LBM can power your patient and member engagement to encourage individuals to adopt and maintain healthier lifestyles, adhere to medical treatments, and engage in preventive health measures like mammograms and vaccinations.

## Pioneering Machine Learning and AI

The culmination of years of research, development, and commercial deployments, Lirio's LBM forms the backbone of an expansive, scalable, and integrated personalization engine.

**This sophisticated system is adept at targeting, coordinating, and optimizing interventions grounded in behavioral science, thereby enhancing their efficacy and impact.**

The engine leverages a multi-agent reinforcement learning framework in which Lirio's LBM can lend knowledge to each engagement model. The LBM is a learned global representation of the behaviorally relevant predictors in any health journey context.

The LBM's comprehensive understanding of relevant data patterns allows this foundation model to be leveraged in many different behavior-based decisions in a health journey. Simultaneously, targeted models can tailor and apply this knowledge to specific tasks, ensuring adaptability and specialization.

Through its integration of proprietary multitask reinforcement learning capabilities, advanced representation approaches, novel optimization techniques, and continuous feedback, our LBM accurately encodes behavioral science expertise into a computational model, culminating in a hyper-personalized approach.

It also incorporates recent ML and AI advances focused on scalable, flexible architectures, sparse, missing, and noisy data, and other innovations required to ensure real-world success.

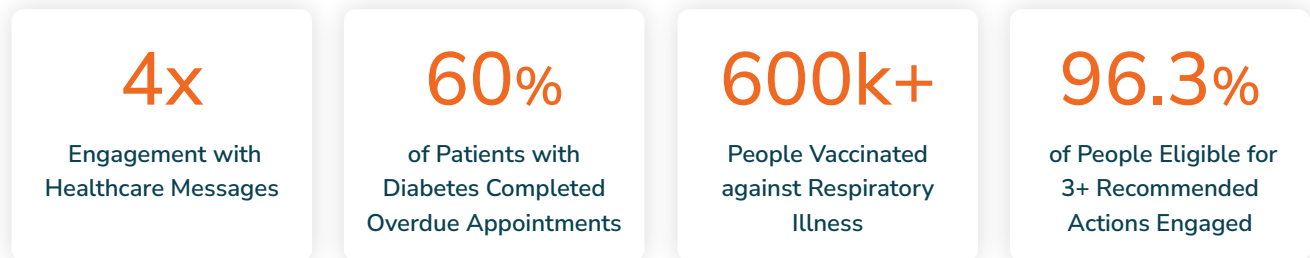
The LBM analyzes diverse data streams – including electronic health records, behavioral patterns, and socio-demographics – for a nuanced understanding of individual preferences and needs across contexts. By better understanding the challenges people may face in seeking care, Lirio's LBM identifies the right BCTs to drive outcomes.

## Meaningful Results Driven By a World-Class Team

Health systems, retail pharmacies, payers, and other organizations are using the Lirio LBM to personalize healthcare communications by virtue of access to tens of millions of patients and consumers. Each of these interactions contributes to the underlying intelligence of our LBM, enabling healthcare-specific personalization across people and contexts..

The LBM has generated proven results directly showing a population-level impact on behavioral conversions and return on investment (ROI), as well as a micro-level impact on the lives of individuals whose engagement leads to early detection, diagnosis, treatment, and management of healthcare conditions.

### Lirio's Results: By the Numbers



Recognizing the importance of academic research and domain expertise, we've cultivated an exceptional team of machine learning scientists and engineers, behavioral scientists, and developers. More than 25% of our team members hold a doctorate in their field.

At the forefront of our commitment to research is our Behavioral Reinforcement Learning Lab (BReLL), an incubator that fuels truly collaborative scientific inquiries, combining the powers of AI and behavioral science while driving the continued evolution of our LBM.

## How the Lirio Large Behavior Model Can Be Used

Lirio's LBM was built to understand the real-life context of health journeys to facilitate an awareness of how to influence people to achieve better outcomes.

Lirio has sent millions of communications encoding behavioral science techniques and tied these to the data and contexts in which they are each most likely to be effective. The model constantly evolves and improves as we engage with new and existing populations using additional behavioral interventions and tactics.

It then informs the creation of a highly individualized, temporally-specific representation that captures a person's healthcare behaviors, motivations, and decision-making processes – which our Personalization Engine can then use to deliver tailored health interventions for each individual in your population.

We call this Precision Nudging®.

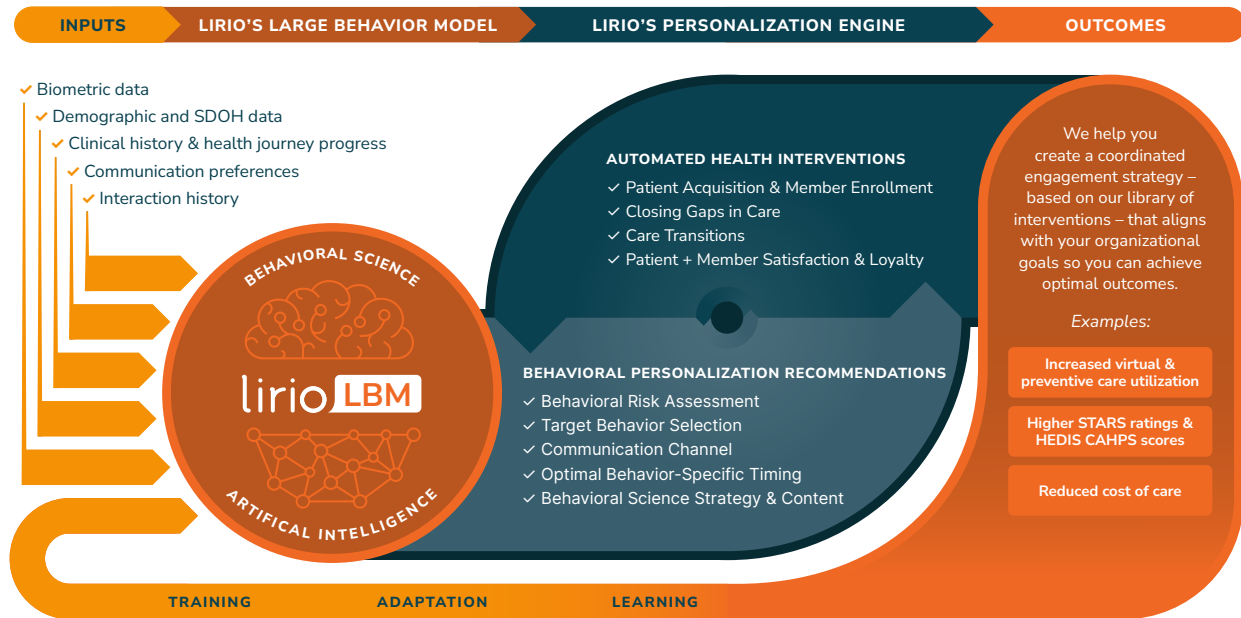
Lirio's LBM can support the creation of health interventions covering many key areas, including:

- **Personalized Health Recommendations:** Tailor behavioral recommendations for individuals to support health goals;
- **Chronic Disease Management:** Provide individualized support for managing conditions like diabetes or heart disease through lifestyle changes, therapy adherence, and at-home care management;
- **Behavioral Health Interventions:** Customize strategies for improved mental health and emotional well-being;
- **Preventive Health Strategies:** Identify and proactively intervene with at-risk individuals;
- **Patient Engagement & Education:** Utilize targeted educational materials to increase healthcare understanding, involvement, and usage of support tools;
- **Medication Adherence:** Encourage consistent and correct use of medications through monitoring and reminders;
- **Postoperative Care & Recovery:** Personalize follow-up care and rehabilitation to enhance recovery, support at-home care, and reduce the risk of hospital readmission;
- **Nutritional Guidance:** Offer diet recommendations tailored to individual health needs, taking account of health conditions, medication use, and other factors;
- **Physical Activity Promotion:** Design exercise programs that align with specific health conditions and goals;
- **Health Risk Assessments:** Use patient data to anticipate and address potential health risks;
- **Healthcare Navigation:** Help people connect with coverage, maximize their benefits, plan for healthcare costs, and support your revenue cycle management.

## Drive High-Impact Behavior Change & Improved Health Outcomes

Our Precision Nudging interventions are based on proprietary algorithms and data and cannot be replicated by publicly available solutions.

The Lirio platform automatically coordinates and optimizes your engagement strategies so all interactions with your healthcare organization become part of the essential context that the LBM uses to better understand individuals and guide population health initiatives.



*Here's how Lirio's LBM helps move people on their journey to better health:*

**STEP 1**

The Lirio LBM uses proprietary health data inputs that include biometrics, social determinants of health (SDOH), and clinical history, alongside individuals' communication preferences and interaction history with your organization.

**STEP 2**

Leveraging our unique behavioral design approach, industry-defining AI, proven results from real-world applications, and continuous learning, the LBM captures the relevant behavioral context to inform how our platform delivers interventions to each unique individual within your population.

**STEP 3**

The Personalization Engine delivers intervention-specific personalized recommendations supported by the LBM. These models can be used to jointly select the top priority target behavior, communication channel, timing, behavioral science strategy, and content with the highest combined probability of effectively driving behavior change for each individual.

**STEP 4**

Lirio's health interventions support improved outcomes by moving people to behaviors like medication adherence, preventative screening, disease management, and more.



## What Makes the Lirio Model Different

Several key differentiators separate Lirio's LBM from any other machine learning models. Here's what you need to know about this transformative technology that automates personalization at the enterprise scale.

### Focused on Human Behavior

We understand that people are different from each other; they are affected by the context in which they live, work, and play, and they change over time. Only Lirio's LBM can account for these dynamics.

Our LBM applies many behavioral-science-backed interventions at scale in various contexts, enabling it to uncover intricate patterns of actions, decisions, and responses.

Lirio's LBM is essentially an always-on virtual behavioral scientist able to choose suitable approaches to support each individual in your population.

This approach is possible because our team of human expert behavioral scientists has conducted extensive research on each specific healthcare behavior we nudge. Moreover, Lirio's AI models have been designed to encode this behavioral expertise in innovative ways.

**Lirio doesn't just understand what people say; we know what they do and why they do it.**

### Created for Healthcare

Regarding behavior change, what works in other industries doesn't work in healthcare. Health is too important and individual to resort to anything less than precision.

That's why we created a specialized model to understand and address the nuances of how individuals interact with their healthcare journeys in a person-centric manner.

Our LBM generates insights deeply rooted in a person's unique medical history and health status. This knowledge allows us to drive effective, hyper-personalized communications around preventative measures, treatment adherence, care utilization, condition management, and more.

**With the introduction of the Health Equity Index for CMS Star Ratings and 2024 changes to the accountable care organization (ACO) Realizing Equity, Access, and Community Health (REACH) model, health equity is more critical than ever.**

Lirio can deliver meaningful outcomes for members of historically underserved groups by addressing the barriers they experience. And the insights from our LBM can support your organization in prioritizing equity-focused initiatives.

We work with your clinical experts and recognized scientific guidelines to encourage people to engage with the recommended behaviors for their health needs.

We flexibly integrate with your care pathways to reduce provider burden, support operational efficiency, and drive your targeted health outcomes.

## Built on Authentic Data and Personalized Health Information

Unlike publicly available information and data – which may lack the depth and authenticity of real-world healthcare experiences – personal health information, clinical history, and social determinants of health fuel our model.

Moreover, our LBM continues to learn how communications supported by behavioral science principles affect actual health outcomes via your organization’s patient or member interaction history. Genuine behaviors, decisions, and engagements within the healthcare ecosystem inform this method.

Responsible data use is part of health equity. To protect the information that drives an LBM, we are committed to security and appropriate use of data to maintain the privacy of the people we serve.

**Our technology is HIPAA and SOC Type 2-compliant and HITRUST certified – the tenets of human subject protection and respect for autonomy guide Lirio’s team and processes.**



## Geared Toward Future Developments and Trends

Foundation models are poised to contribute to significant advancements in healthcare across a broad spectrum of applications, heralding a new era of technological innovation and improved patient outcomes.

Lirio's LBM, despite its sophistication, is only beginning to realize its potential. As we look ahead, we anticipate being able to capitalize on several trends and opportunities. These include:

- **Academic and industry research in behavioral science and AI are evolving quickly.** Not only do we continue to make our own research advances that directly affect our product, but as a science-driven organization, we are constantly monitoring and looking to adopt the most promising research advances from other sources. These developments can only help us to enhance our LBMs' predictive accuracy and personalization capabilities.
- **Digital engagement and interactive technologies are increasingly prominent in the healthcare landscape.** Greater interoperability with emerging health technologies, including wearable devices and telehealth platforms, will broaden the scope of data inputs and extend the reach of LBMs.
- **Machine learning systems evolve at an accelerated pace when you can iterate and improve your approach based on large amounts of relevant data.** Lirio's scientists are driven to continuously improve our solution to support our mission to drive better health outcomes. Therefore, we are taking full advantage of our ability to improve our LBM through the unique data we can access and continue to generate through targeted, behavioral-science-backed interactions.
- **The ability to create powerful data artifacts relevant to any domain continues to become more feasible.** Lirio has some of the world's deepest expertise in geospatial analytics and behavioral geography. We are leveraging this expertise to develop our own geospatial, community-health foundation model that will feed our LBM, providing more consistent and better insight into many SDOH factors that are particularly relevant to health behavior change.

As these innovations evolve, LBMs will become even more integral to personalized healthcare, offering predictive insights and interventions precisely tailored to each patient's unique health journey.

Building on this trajectory of innovation and enhanced capabilities, LBMs can serve as digital twins – models uniquely designed to mirror and understand human behaviors and decision-making processes computationally. Built on sophisticated artificial intelligence algorithms that capture and learn how to represent essential contextual clues in a health journey, they can be used to anticipate future behaviors and health events.

Moreover, when repeatedly trained on responses to expertly designed behavioral interventions in the context of countless health journeys, as Lirio's LBM is, they will continue to help us better understand what interventions will work for different individuals to change said behaviors and, more importantly, to change outcomes.

## Unlock the Future of Healthcare Communication

The power of our LBM helps health systems, providers, payers, and consumer health organizations chart a course where healthcare communication isn't simply tailored; it's profoundly personal.

We're ready to help you see the path and shape the journey for better health outcomes across your entire population, delivering personalized attention on a one-to-one basis yet achieving this at a large scale.



Contact us to schedule a demo and see how the Lirio LBM can work for your organization.



[lirio.com/contact-us](https://lirio.com/contact-us)