

What Does a Person Think When Told to See a Neurologist? How Mind Genomics Thinking + Artificial Intelligence Enable Synthetic Experiments

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Abstract

Understanding a patient's thoughts and feelings is crucial in medicine, particularly in neurology, where neurological conditions can impact their thinking, feelings, and actions. The paper shows how AI (large language models, LLM) allows the doctor to specify an illness and in turn request the AI to return with different things that the prospective patient might be thinking. The approach is demonstrated for visits to the neurologists by males versus females, age 20, 40, 60, and 80, and finally visits to see a neurologist suggested by the primary care physician versus suggested because the patient has issues with gait. The approach provides a new way to help doctors become more sensitive to the often unstated but real emotional needs of their patients.

Keywords

Artificial intelligence, Mind Genomics, Synthetic experiments.

ABBREVIATIONS

AI: Artificial Intelligence, ChatGPT: Chat Generative Pre-trained Transformer, LLM: Large Language Model.

INTRODUCTION

When doctors can think like their patients, they can better understand how they are feeling and what they need. Many neurological conditions can affect how a person thinks, feels, and acts, making the task more difficult. To think like a patient in neurology, a doctor might first ask the patient to describe their symptoms in detail. This could include things like headaches, dizziness, trouble walking, or memory problems. The doctor would then try to imagine how these symptoms might affect the patient's daily life, and how the patient might be feeling emotionally. The doctor might also ask the patient questions about their medical history, any medications they are taking, and any past injuries or illnesses. By knowing more about the patient's background, the doctor can better understand why they might be experiencing certain symptoms. The doctor might also pay attention to how the patient is speaking and moving, as these can give clues about their thoughts and feelings.

By understanding what a patient is thinking and feeling, doctors may be empowered to provide care powered by understanding of the "patient as a person," rather than simply the "patient as

a person with a condition." This does not mean empowering the patients, however. Studies in the UK suggest that giving the patient choices does not necessarily make the patient happier [1]. Overall, knowing how to think like a patient is a valuable skill for doctors in any field, but especially in neurology. By using the knowledge obtained through AI (large language models, LLM) doctors can build better relationships with their patients, provide more accurate diagnoses, and come up with more effective treatment plans [2-6].

The approach presented here emerged from the use of Mind Genomics to understand how to communicate with patients to achieve compliance in a positive fashion [7]. The objective in that study and in similar studies was to identify the words that would generate compliance in the early days of the COVID-19 pandemic. The important thing was the need to do actual experiments with people in order to understand the proper language. In a sense, one had to know the answer, and then use Mind Genomics thinking in order to sort through the responses of real people. From the pattern of responses one quickly discerned the relevant elements or messages, and then discovered how the person thought about the topic from the



commonality of strong performing elements emerging from the Mind Genomics experiment.

The roadblock to massive increase in understanding was the requirement to do actual studies, requiring understanding messaging of various types, and executing experiments with 50 or more human respondents in a study. In addition, the universities often required approval by ethics committees, approvals all too often given grudgingly, and months after the request was made [8]. Although the approvals by ethics committees took months, the actual studies took hours, from start to finish, and onto deep analyses [9,10].

Moving the Learning to AI and LLMs (Large Language Models)

This paper began as part of a series of experiments to move the foregoing effort to AI, speed up the process, and make it affordable everywhere. The general problem was to understand what one should say whether to a patient, a new legal client, or a new customer in a store. In other terms, use AI to teach the proper "bedside manner" in various client-facing situations.

Although it is taken for granted that the experienced person knows what to say to the customer, not everybody is experienced. With the world coming out of COVID with such changed behaviors due to a great deal of one's time spent alone in front of the small screen rather than in a one-to-one conversation, it is becoming increasingly important for people in the service businesses, such as medicine, to understand individuals whom they serve. Whether we like it or

not, doctors are always judged on their bedside manners. It is in the nature of patients to discuss doctors, and indeed, even before one's clinical abilities or one's doctoral capabilities are known, the word around a doctor is her or his bedside manner. Is it possible to use artificial intelligence to teach bedside manner? [11-14].

The Contribution of Mind Genomics Thinking

The beginnings of the actual study here were done decades ago when the senior author founded the now emerging science of Mind Genomics [15,16]. Mind Genomics mixes messages that might be used in a topic area, creating "vignettes," presents these vignettes to survey takers, and then using statistical regression analysis, estimates the strength of each message to drive patient comfort or cooperation. The patient or survey taker need not take an active role, but rather simply respond to the vignettes. The answers in the form of coefficients of a regression model usually made sense, more so when the respondents or survey takers were divided into like-minded individuals, so-called mind-sets. It became obvious at the time that one could apply this to compliance, such as behavioral changes for congestive heart failure [9], colonoscopies [17], and even to understand motivations for COVID-19 vaccines among parents of young children [18], and so forth.

How to Do Mind Genomics-Type Experiments With AI (LLMs)

The question kept emerging as to whether one would actually need the experiments themselves or would it be possible to do these kinds

Table 1: The prompt and answers for an individual told by their primary care physician to see a neurologist. No specific reason is given.

Write a six sentence paragraph for a person told by their primary care physician to see a neurologist. In that paragraph describe the thoughts going through the mind of the person.

1. MALE, 20 YEARS OLD: As a 20-year-old man, the thought of seeing a neurologist is daunting. I never imagined having to deal with potential brain issues at such a young age. What could be wrong with me that my primary care physician thinks I need to see a specialist? Will I have to undergo extensive testing? What if they find something serious? How will this affect my future plans and goals? The uncertainty and fear are overwhelming as I wait to see the neurologist.
2. MALE, 40 YEARS OLD: At 40 years old, the news of needing to see a neurologist is concerning. I never thought I would have to face potential brain problems at this stage in my life. What could be causing my symptoms that my primary care doctor couldn't diagnose? Will I have to make major lifestyle changes or take medication? How will this impact my career and family? The worry and uncertainty loom large as I wait for my appointment with the neurologist.
3. MALE, 60 YEARS OLD: Being a 60-year-old man, the idea of seeing a neurologist is both frightening and unsettling. I never expected to face potential brain issues at this stage in my life. What could be causing my symptoms that my primary care doctor couldn't address? Will I have to consider retirement or long-term care options? How will this impact my relationships and legacy? The anxiety and fear are palpable as I prepare to meet with the neurologist.
4. MALE, 80 YEARS OLD: As an 80-year-old man, the thought of seeing a neurologist is intimidating. I never imagined having to deal with potential brain issues at this age. What could be causing my symptoms that my primary care doctor couldn't address? Will I have to consider hospice care or end-of-life decisions? How will this impact my legacy and relationships? The fear and anxiety are overwhelming as I wait to see the neurologist.
5. FEMALE, 20 YEARS OLD: Being a 20-year-old woman, the idea of seeing a neurologist is both scary and frustrating. I don't understand why my primary care doctor would refer me to a specialist for brain-related issues. Will I have to deal with costly treatments and medications? How will this impact my daily life and relationships? I can't help but worry about what the neurologist will find and how it will affect my future. The anxiety is consuming as I prepare for my appointment.
6. FEMALE, 40 YEARS OLD: As a 40-year-old woman, the thought of seeing a neurologist is overwhelming. Why does my primary care physician think I need to see a specialist for brain-related issues? What if there's something seriously wrong with me? Will I have to undergo invasive procedures or surgery? How will this affect my daily routine and family life? The fear and apprehension are consuming as I wait for my appointment with the neurologist.
7. FEMALE, 60 YEARS OLD: At 60 years old, the news of needing to see a neurologist is daunting. Why does my primary care physician believe I need to consult a brain specialist? Will I have to face serious health issues and treatments? How will this impact my retirement plans and family dynamics? The uncertainty and concern weigh heavily as I wait for my appointment with the neurologist.
8. FEMALE, 80 YEARS OLD: Being an 80-year-old woman, the news of needing to see a neurologist is distressing. Why does my primary care physician believe I need to consult a brain specialist at this stage in my life? Will I have to face severe health challenges and limitations? How will this impact my end-of-life plans and family dynamics? The unease and trepidation are pervasive as I prepare for my appointment with the neurologist.

Table 2: The prompt and answers for an individual told by their primary care physician to see a neurologist, the reason being problems with “gait” when walking.

Write a six-sentence paragraph for a person told by their primary care to see a neurologist. In that paragraph describe the thoughts going through the mind of the person. Each person has reported difficulty in “gait” when walking.

1. FEMALE, 20 YEARS OLD, GAIT: As a 20-year old woman, hearing my primary care suggest seeing a neurologist due to my difficulty in walking, specifically in my gait, leaves me feeling anxious and worried. Could this be a sign of a more serious underlying condition? Will this impact my ability to be independent and go about my daily routines? What treatment options will the neurologist recommend? Could this affect my relationships and social life? Will I need to make significant lifestyle changes to accommodate this issue? How will this impact my future plans and aspirations? Should I seek a second opinion before proceeding with the neurologist appointment?
2. FEMALE, 40 YEARS OLD, GAIT: As a 40-year old woman, the suggestion from my primary care to see a neurologist because of my difficulty in walking, specifically in my gait, leaves me feeling anxious and uncertain about my health and future. What could be causing this issue at my age? Will this impact my ability to care for my family and manage my household responsibilities? How will this affect my relationships with friends and loved ones? Should I inform my employer about this health concern and any potential accommodations I may need? What treatment options will the neurologist recommend? Is this a temporary issue that can be resolved with therapy, or is it a more serious condition that requires ongoing care and attention?
3. FEMALE, 60 YEARS OLD, GAIT: As a 60-year old woman, hearing my primary care advise me to see a neurologist because of my difficulty in walking, specifically in my gait, fills me with a mix of fear and uncertainty about my health and future. What could be causing this issue at my age? How will this impact my ability to stay active and engaged in my community and social circles? Will this affect my independence and ability to care for myself? What treatment options will the neurologist recommend? Should I share this news with my family and friends, or keep it private until more information is available? Will I need to make lifestyle changes to accommodate this issue, and if so, how will that impact my daily routine and activities?
4. FEMALE, 80 YEARS OLD, GAIT: As an 80-year old woman, the recommendation from my primary care to see a neurologist because of my difficulty in walking, specifically in my gait, fills me with a mix of fear and resignation about the challenges of aging. Will this impact my ability to live independently and care for myself? How will this affect my relationships with my spouse and family members? Should I share this news with my closest friends, or keep it private until more information is available? What treatment options will the neurologist recommend, and will they improve my mobility and overall quality of life? Will I need to make significant changes to my living arrangements to accommodate this issue? Am I prepared for the potential outcomes of this medical concern as I continue to age and navigate the complexities of my health and well-being?
5. MALE, 20 YEARS OLD, GAIT: As a 20-year old man, the suggestion to see a neurologist because of my difficulty in walking, particularly in my gait, is both concerning and perplexing. I can't help but wonder what could be causing this issue at such a young age. Will this impact my ability to pursue my dreams and goals? How will this affect my everyday activities and social life? What will the neurologist find during the examination? Will I require medication or therapy to improve my gait? Is there a chance this could be a lifelong issue for me? Am I overreacting or should I take this seriously and seek immediate medical attention?
6. MALE, 40 YEARS OLD, GAIT: As a 40-year old man, the recommendation from my primary care to see a neurologist because of my difficulty in walking, particularly in my gait, is a sobering realization of my aging body. Will this impact my career and ability to provide for my family? How will this affect my overall health and well-being in the long run? What will the neurologist find in their assessment? Will I need to make significant changes to my lifestyle and daily routine? Is this a common issue for people my age, or is it something more serious that requires immediate attention? Should I be concerned about the potential outcomes of this medical issue?
7. MALE, 60 YEARS OLD, GAIT: As a 60-year old man, the suggestion from my primary care to see a neurologist because of my difficulty in walking, particularly in my gait, makes me realize the effects of aging on my body and mind. What could be causing this issue at my age? Will this impact my ability to enjoy my retirement and pursue my hobbies and interests? How will this affect my relationships with my spouse and children? Should I prepare for the possibility of needing long-term care or assistance with my mobility? Will the neurologist provide treatment options that can improve my gait and overall quality of life? Am I at risk for developing other health issues as a result of this difficulty in walking?
8. MALE, 80 YEARS OLD, GAIT: As an 80-year old man, the suggestion from my primary care to see a neurologist because of my difficulty in walking, particularly in my gait, brings a sense of resignation and acceptance of the challenges that come with aging. How will this impact my ability to live independently and stay active in my later years? Will this affect my relationships with my children and grandchildren? Is this a common issue for people my age, or is it a sign of a more serious health condition? What treatment options will the neurologist recommend, and will they improve my quality of life? Should I prepare for the possibility of needing additional care and support as I age? How will this impact my overall outlook on life and my sense of purpose in my golden years?

of experiments by prompting the LLM that we wanted to find out something about how a patient thinks. What should one say? The results were straightforward and encouraging. What was needed simply was a method by which one could systematize as a prompt. The method presented here asks a simple question: *what is a patient thinking?* That's all. The results are remarkably surprising, providing a rich expansion of knowledge. The results are not meant to be clinical, but rather presumed to be what a normal person might think. The procedure follows a series of simple steps. The user sets up an account at www.BimiLeap.com. This is the website from which the user can easily access the LLM (ChatGPT 3.5). Any other access point

would be satisfactory, and other LLMs besides ChatGPT 3.5 might work equally as well.

The user writes a request about asking the LLM to define what goes through the mind of a person of a specific age and gender about the thought of seeing a neurologist. Table 1 shows the prompt and then the answer. The individual is told by the doctor or his primary care physician to see a neurologist. That prompt is followed by the list of eight different types of people (male vs female; four ages). The LLM is instructed to return the answer separately for each of these eight groups. It is this type of information which is the education to be had.

Rather than presenting clinical issues, it is teaching the neurologist what might be going through the person's mind and to be sensitive to the types of questions that might be asked.

Table 1 presents the "answers" for the eight individuals told by their primary care physician to see a neurologist, but without any other information. Table 2 presents the same types of "answers" for these same eight individuals, this time told by their primary care physician to see a neurologist because of problems with their gait. The important thing to consider in both tables is the sensitization of the reader to the mind of the prospective patient, and the opportunity to learn the impact on the patient of discovering that there might be a problem.

DISCUSSION AND CONCLUSIONS

Neurologists learn how patients think through a combination of medical training, clinical experience, and research. They gather information about a patient's cognitive abilities, emotional state, language skills, and other factors through a series of assessments and evaluations. They also take into account the patient's medical history, family history, and lifestyle factors which may influence thinking patterns.

The focus of neurology and thinking tends to be on thinking as a topic itself, a topic of study for neurology. Today's neurologists have a better understanding of how patients think compared to in the past, thanks to advancements in brain imaging technology and cognitive neuroscience research. They are able to study patterns of brain activity associated with different thought processes and behaviors, allowing them to make more accurate diagnoses and treatment plans for patients with neurological conditions.

The focus of these studies is not on patient thinking as a topic, but as something to be understood to improve one's bedside manner. Whether one wishes to deal with the issue or not, how the patient feels as a patient is important. It may end up involving the choice of neurologist, the trust in what the neurologist says and prescribes, and ultimately a trust, which could impact the short and long term outcomes of the treatment. The world of medicine has recognized the importance of the way the patient thinks, and indeed the emotional experience with the neurologist. There have been at least five directions taken by neurology and neurologists to create a better experience for the patient, one which can allay the normal fears expressed in Tables 1 and 2, respectively.

1. Brain-computer interfaces allow neurologists to directly access and interpret a patient's thoughts and fears. These interfaces provide real-time feedback on a patient's brain activity, giving neurologists a more accurate understanding of their mental state [19].
2. Virtual reality therapy sessions before a patient's appointment with a neurologist immerse patients in a virtual environment designed to simulate their fears and anxieties, allowing neurologists to better understand and address these issues during their consultation. This method has been shown to significantly reduce patient anxiety and increase their comfort level during appointments [20].
3. Neurologists incorporate mindfulness techniques into their practice to help patients better manage their fears and thoughts. By teaching patients how to be present in the moment and recognize their emotions, neurologists help patients navigate their concerns more effectively. This approach has been particularly effective in helping patients with neurological conditions such as Parkinson's disease and epilepsy [21].

4. Machine learning algorithms analyze a patient's speech patterns and facial expressions during consultations. By identifying subtle cues in a patient's communication, neurologists can gain insights into their underlying fears and thoughts. This technology has proven to be highly accurate in predicting patient emotions and providing personalized care [22].
5. Finally, advancements in telemedicine enable neurologists to conduct virtual consultations with patients, providing a more convenient and accessible way for patients to seek help for their fears and thoughts. Through secure video conferencing platforms, neurologists can connect with patients in real-time and offer support and guidance remotely. This has been particularly beneficial for patients who may have difficulty accessing traditional in-person appointments due to physical or geographic limitations [23].

The use of LLMs in the spirit of these five foregoing advancements is more holistic, treating the person as a whole, as a totality. One might well consider the synthesis of thinking and the mind as the sixth innovation in the world of neurology.

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