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推　薦

医学部医学科小論文問題 2

注意事項

1. 試験開始の合図があるまでこの問題冊子を開いてはいけません。
2. この問題冊子のページ数は 11 ページです。問題冊子、解答用紙（3 枚）、及び下書き用紙（2 枚）に落丁、乱丁、印刷不鮮明などの箇所がある場合には申し出てください。
3. 解答は指定の解答用紙に記入してください。
   (1) 文字はわかりやすく、横書きで、はっきりと記入してください。
   (2) 解答の字数に制限のある場合は、それを守ってください。
   (3) 解答用紙にマス目のある場合は、訂正、挿入の語句は余白に記入してください。
   (4) ローマ字、または数字を使用するときは、マス目にとらわれなくてもかまいません。
4. 試験時間は 90 分です。
5. 解答用紙は持ち帰ってはいけません。
6. 問題冊子と下書き用紙は持ち帰ってください。

以下の文章を読んで問 1-問 13 に答えなさい。*の付いた語には末尾に訳注があります。

Artificial intelligence (AI) has been defined as the capability of a machine to mimic intelligent human behaviour. To limited extents, AI has arrived. We can give orders to our smartphones and talk to devices such as smart speakers and ask them to update us about the day's weather and traffic. They don't perform perfectly, yet the ability to understand and respond to human speech is advancing rapidly. <u>(1) How long might it be before speech recognition, machine learning, and other developments in AI will offer tools to medicine, and how might those tools offer insights into what happens between clinicians and patients?</u>

Novel ways to manage practice tasks

AI research involves the development of "intelligent" computer agents. Traditionally, AI encoded existing knowledge about the world and thereby relied on prespecified human expertise. The hard coding* of information into AI algorithms was typically a (2－1) process. An alternative approach, known as machine learning, relies (2－2) on prior assumptions and enables computers to develop algorithms based on repeated trials and errors. Although this still requires expert human input, the time to develop AI algorithms is now often much (2－3). Machine learning is <u>(3) prominent</u> in tasks such as creating the equivalent of eyesight for computers, enabling self-driving cars for instance.

Machine learning has potential to have a big effect on medicine, and AI applications are beginning to emerge in healthcare. Many clinicians may prefer to use their voice rather than keyboard and mouse to interact with technology. Some, such as radiologists*, already interact with digital systems using voice and physical gestures, and studies suggest important productivity gains, although efforts are needed to ensure safety and efficiency.

When clinicians enter a diagnosis for their patient into a system, they might expect guidance about confirmatory tests and reasonable treatment options. AI has been used to guide decisions such as the safety of combining a β blocker* with a drug for arrhythmia* and can help clinicians diagnose late-onset sepsis* in premature infants.

Potential role in communication with patients

An unexplored application of AI is analysis of communication in healthcare. Medical schools have all invested in teaching communication skills, but there is concern that the skills remain basic and don't get much better after students qualify. There is ample evidence that communications skills can be effectively developed and sustained. Some specialties emphasise this during early training, notably primary care and psychiatry*, using powerful methods such as simulations and feedback with video recordings. However, most specialties do not use these methods, and the communication skills of clinicians are often not formally assessed during training or during their years in practice.

The effect of routine assessment of clinicians' communication performance has not been studied, primarily because the analysis methods are too time-consuming and expensive. However, there is consistent evidence that clinicians struggle to convey information, check understanding, and engage patients in decision making. (4) The lack of any effective feedback about performance makes it difficult to improve. Use of AI to assess digital recordings could provide personalised, and if necessary, confidential, detailed feedback to individual clinicians as well as comparing their performance to that of their peers. Box 1 gives some examples of the (5) communication metrics that could be recorded and Figure 1 shows how they might be presented to clinicians.

What might be possible?

AI could assess communication skills at much lower costs than current methods. Other sectors are already using analysis of speech and text. For example, Cogito Corp, a spin-out from Massachusetts Institute of Technology, provides call centres with voice analysis data, providing real-time feedback to employees about dominating conversations or appearing distracted. Employees receive targeted advice about how to improve their communication, and there are preliminary reports of improved performance. As AI becomes better at recognizing speech, irrespective of accents or language, human-machine interfaces are being mediated by talking to virtual assistants such as Siri and Alexa.

We believe speech recognition could change the way we assess clinicians' communication in medicine. Here, we outline three areas where progress is being made by some innovative groups: meaning, turn-taking*, and tone and style.

Box 1: Communication metrics that could be derived by AI analysis of consultation.

Delivery

Speaker ratio — Proportion of talk by patient and clinician. Indicates willingness to listen.

Overlapping talk — Interruption or simultaneous talk. Indicates respect for contribution.

Pauses — Number of pauses longer than 2 seconds, which invite contribution. Indicates willingness to listen.

Speed of speech — Pace can influence comprehension. Indicates wish to be understood.

Energy (pitch and tone) — Influences perceptions (eg, interest and empathy*).

Content

Plain language — Word choices, sentence length, and structure.

*Clinical jargon** — Choice of terms and effort to explain technical words.

Shared decision making — Effort to inform, elicit*, and integrate preferences into decisions.

Meaning: analysis of words and phrases

Automated historical or real-time analysis of words and phrases could lead to innovations that were previously inconceivable. Feedback could specify whether patients and clinicians are likely to have understood each other, how aligned they were in their manner of expression, or whether the patient was encouraged communication elements manually using measures such as Observer OPTION-5 for shared decision making. Automated analyses of recordings could accelerate these kinds of analyses and assess whether clinicians are taking appropriate histories, offering evidence based treatments, providing information to patients in accessible language that is free of jargon, eliciting patient views, and pausing to offer patients opportunities to talk. Our research team is already exploring the use of natural language processing in many of these tasks.

Eventually, just-in-time methods might analyse conversations in real-time and prompt clinicians to consider diagnoses that might not be obvious or to offer a wider range of treatment options. As machine learning becomes adept* at analyzing real-time speech, it may become possible to assess diagnostic reasoning and the appropriateness of therapeutic decisions.

Turn-taking analysis

Analysis of turn-taking could provide important insights into dialogue patterns. AI could intervene to temper knee-jerk* decisions to order invasive investigations —for example, cases where more detailed questioning might have led to a diagnosis of heartburn or possible muscular strain, rather than a presumption of cardiac* pain.

To what extent do clinicians allow patients uninterrupted time to explain their reason for the visit? What proportions of time do patients and clinicians spend speaking? Does the clinician pause to allow the patient to voice concerns or ask questions? Allowing the patient space to talk can be an act of empowerment*. Turn-taking can be correlated with important measures such as patients' adherence* to medicines, satisfaction, and recall of information.

Tone and style in interactions

Analysis of pitch, timbre*, pace, and social signals requires high quality audio recordings but could lead to many innovations and benefits to patients. We could consider questions such as whether intonation, pitch, and pace affect trust and, in turn, influence other outcomes such as patient motivation or adherence to treatment recommendations. In one research study, people's rating of the tone of voice of surgeons was associated with the likelihood of surgeons facing malpractice* litigation*. After the implementation* of appropriate data collection mechanisms, relationships such as this can be explored systematically, giving clinicians better understanding of their subtle strengths and weaknesses in communication.

In the aviation sector, pilots' key communication skills have been assessed by using algorithms to analyse their vocal pitch and energy. Adaptation of such methods to the health sector might help detect high risk situations when clinicians are under stress or subjected to workloads that might affect how well they communicate. Automated analysis of pitch, timbre, and pace might support rapid detection of situations with a raised risk of potential malpractice claims. Non-verbal vocalisations may also be relevant —friendly laughter has been associated with reduced likelihood of malpractice, for example.

Analysis of voice patterns could prove a rich source of information about patients' emotional states or may detect early features of illness or cognitive deficits. Some pioneers are already exploring the detection of disease by analysing speech patterns in patients. For instance, depressive episodes can be marked by systematic changes in vocal pitch, and early identification of heart failure may be feasible* by measuring vocal changes arising from oedema* in the vocal folds* and lungs.

Technical barriers

Based on current research progress, we estimate that routine, useful analysis of clinicians' intonation and turn-taking will be feasible in a few years. (6) Rudimentary* content analysis, such as mapping of key clinical concepts and conversation topics, could be implemented in five to 10 years. More comprehensive content analysis, including real-time guidance on diagnosis and treatment plans, is likely to take longer.

Healthcare poses particular challenges in applying speech recognition. Clinical encounters comprise an intricate weave of at least two people speaking, often with overlapping speech. The dialogue is varied and includes greetings and partings, inquiry (history taking), explanation (for example, of diagnoses), negotiation around options, encouragement of adherence, and the provision of advice and reassurance. Skilled clinicians adjust their communication style to the needs of their patients and often use unusual technical vocabulary and similar sounding words. At present, even the most advanced AI systems are incapable of parsing* and assessing the complexity of dyadic* clinical interactions.

High quality digital recordings are essential for sophisticated AI analysis. This requires use of multiple microphones —for example, the clinician wearing a lapel* microphone and a microphone array on a table in front of the patient. Such recordings can underpin* a range of analyses, including speaker identification, semantic* interpretations of words and phrases, and the assessment of vocal attributes such as pitch, pace, and timbre, which often indicate emotional states and correlate with the effectiveness of communication. Box 2 describes the progress on current technical barriers to using AI analysis.

Box 2: Technical barriers and potential solutions.

Turn-taking

Performance feedback requires digital recordings of clinical encounters that use more than one high quality microphone. The microphones can be embedded* in a single device, known as a microphone array. The Amazon Echo device, for example, contains seven microphones. Using more than one microphone enables more accurate discrimination, because time lags between audio signals are used to separate speaker identities. Details such as avoiding contact between lapel microphones and clothes would help to reduce background noise and improve sound quality. Technical solutions have been developed to automate turn-taking analysis, and research is ongoing.

Meaning

Turn-taking analysis is a stepping stone to more sophisticated analyses. When an AI system can identify individual speakers, the next step is to characterize the voice and words spoken; this leads to a leap in analytical potential. But first, speech recognition, where speech is converted into text by computers, must become more accurate. Advances in this area are ongoing, and some systems are near 5% error rates under specific conditions. This is inadequate for real-time analysis of clinical care, but machines are incrementally approaching human levels of accuracy.

Even if perfect transcriptions were possible, the ability of AI systems to interpret transcribed text is limited. Computers have difficulty in interpreting linguistic ambiguity, such as identifying the referent of pronouns. Although a clinician may immediately recognise whether the pronoun "it" alludes* to a medication or a diagnosis, an AI system is likely to misinterpret such statements.

Assessing non-linguistic features: pitch, timbre, pace, and social signals

Again, the analysis of vocal features relies on high quality audio files and access to large numbers of recordings to facilitate machine learning through incremental improvement of algorithms. Microphones should minimize background noise while clearly capturing the speech of interest. Non-linguistic analysis of voice is already deployed in settings such as call centres to provide real-time feedback on emotional intelligence.

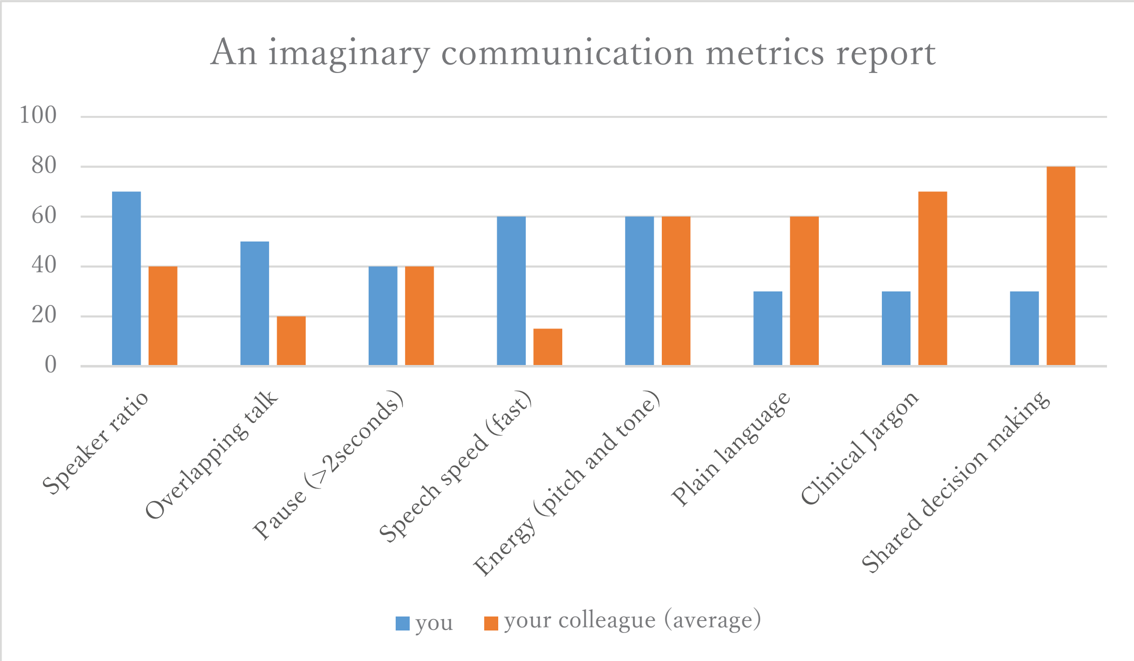

Figure 1 An imaginary communication metrics report

(Ryan P, Luz S, Albert P, Vogel C, Normand C, Elwyn G. Using artificial intelligence to assess clinicians' communication skills. BMJ. 2019; 364: l161. より引用、一部改変． Adapted by permission from BMJ Publishing Group Limited. The BMJ, Padhraig Ryan, Saturnino Luz, Pierre Albert, Carl Vogel, Charles Normand, Glyn Elwyn, 364, 161, 2019.)

訳注

hard coding	コンピュータプログラムのソースコードに直接書き込むこと
radiologist	放射線科医
β blocker	β阻害薬(高血圧の治療薬)
arrhythmia	不整脈
sepsis	敗血症
psychiatry	精神医学

turn-taking	話者交替
empathy	共感
jargon	難解な専門用語
elicit	引き出す
adept	熟達した
knee-jerk	型にはまった
cardiac	心臓の
empowerment	権利拡大
adherence	患者が主体的に治療に参加すること
timbre	音質
malpractice	医療過誤
litigation	訴訟
implementation	実行
feasible	実現可能な
oedema	浮腫
vocal fold	声帯
rudimentary	初歩的な
parse	構文解析する
dyadic	二人の
lapel	(上着・コートなどの)折り襟
underpin	土台を補強する
semantic	意味の
embed	はめ込む、埋める
allude	ほのめかす

問1　下線部(1)を日本語に訳しなさい。

問 2　医学生の意思疎通能力を高める方法として以前から知られていたが、実際には教育現場でほとんど実践されていなかった手法とはどのようなものかを、本文から 10 語以内で抜き書きしなさい。

問 3　空欄 (2-1) ～ (2-3) にあてはまる単語を以下の A～E から選び、記号で答えなさい。

(2-1)　A. lengthy　B. quick　C. short　D. easy　E. simple
(2-2)　A. more　B. better　C. further　D. less　E. worse
(2-3)　A. longer　B. heavier　C. more complex　D. lighter　E. shorter

問 4　下線部(3)の類義語として不適当なものを以下の①～⑩から 2 つ選び、数字で答えなさい。

① striking	② superficial	③ spectacular	④ outstanding	⑤ esteemed
⑥ discreet	⑦ remarkable	⑧ salient	⑨ noteworthy	⑩ distinguished

問 5　下線部(4)のような状況に対して AI の利用によって何ができる可能性があると述べられているか、本文に即して説明しなさい。

問 6　下線部(5)の具体的な指標となる項目を箇条書きで説明しなさい。

問 7　Turn-taking analysis の項目の一つとして、医療者の発言の間が挙げてある。適切な間がないと何が問題であるのか、本文に即して説明しなさい。

問 8 「意味、語句や言い回しの分析」において AI が進歩すると、最終的にどのようなことが可能になるかも知れないと著者は考えているか、説明しなさい。

問 9　声の調子、話しぶりの分析から明らかになる可能性がある病態が本文に 2 つ挙げてある。以下の①～⑩から 2 つ選び、数字で答えなさい。

①頸部癌　②急性腎障害　③胸やけ　④筋緊張　⑤心臓に起因する痛み
⑥心不全　⑦抑うつ状態　⑧眼疾患　⑨敗血症　⑩不整脈

問 10　下線部(6)とはどのようなものか。40 字以内で説明しなさい。

問 11　AI 分析を使用する際の現在の技術的障壁として、どのようなものが述べられているか、説明しなさい。

問 12　Figure 1 において、”You”の communication skill の問題点を説明しなさい。

問 13　AI では測れない医師の communication skill としてはどんなものが考えられるか。具体的な例を 1 つ挙げて説明しなさい。

（以下、余白）