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Research and Review on Chatbots in Digital Mental Health

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Abstract: In recent years, with advanced technology, various kinds of artificial intelligence (AI) applications in different domains are booming. However, chatbots in the field of digital mental health are still in their early stages and have not yet been widely adopted. Since people's psychological problems have become increasingly prevalent in society, and many have not been handled, this paper provided comprehensive research and review on the necessity and potential for AI to address the psychological issues faced by the Chinese population through a questionnaire investigation. The questionnaire investigation aimed to gather information on people's attitudes towards using chatbots in digital mental health as a solution. The responses were collected from diverse age groups of participants, including both males and females and varying provinces of residence in China. Overall, the results of the questionnaire investigation showed the possible future of this kind of chatbot among Chinese people.

Keywords: Chatbots, Mental Health, Chinese, Possibility

1. Introduction

In the new era, China has witnessed a dramatic increase in the number of people suffering from mental illnesses, especially after the COVID-19 pandemic [1]. However, there is a severe lack of psychiatrists compared to patients, leading to a significant gap between the demand and the supply [2]. Besides, Chinese traditional concepts and beliefs also make them feel unwilling to consult a doctor, especially minors who are under the care of their parents [3]. With the rise in the application of industrial robots in China after 2005 [4], other kinds of robots were in need. Chatbots in digital mental health, in particular, should be introduced to meet people's needs, provide much-needed support and, fill the gaps in the mental health system. Although China has already had a rich background in industrial robots and existing models and technologies in mental health-oriented chatbots, there is a lack of research on their feasibility in China. Due to the unique characteristics of this country and its national conditions, this article proposed a design of a questionnaire to analyze the possibility of the application of mental health-oriented chatbots in China.

This research is crucial as it can provide unique insights by exploring the possibility of chatbots in digital mental health applications. Then, the country can make some progress in addressing the mental health challenges faced by its population to some extent.

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2. Literature Review

2.1. Situation and background

To find the necessity and possibility of Chatbots in Digital Mental Health, an analysis of China's real condition in the field of robots and mental health is needed.

China has been a major player in the industrial robotics market and held the position of the world's largest user of industrial robots in 2016, accounting for approximately 30 percent of the global marke. This demonstrated that China's utilization of robotics technology existed.

Between 2006 and 2015, there was a steady increase in the number of annual installed units of industrial robots (In Figure 1). It indicated that China had a high demand for robots as the variety of robots in the market became abundant. [4]

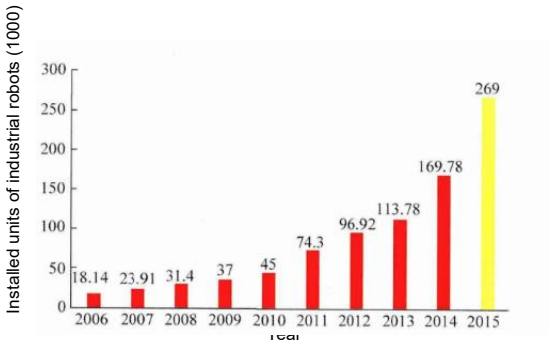

Figure 1: Annual installed units of industrial robots 2006-2015 in China. [4]

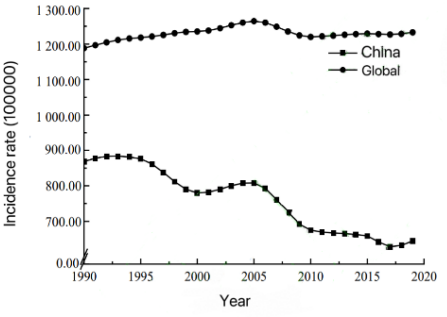

Figure 2: Trends in incidence rate of depression among adolescents from 1990 to 2019 on a global and national scale. [5]

According to the World Mental Health Report released by the World Health Organization in 2022, it was found that nearly 12.5 percent of people suffer from varying degrees of mental disorders worldwide [2]. In China, although the incidence rate of adolescent depression was lower than that in the world from 1990 to 2020 (In Figure 2), the number of people who were under 18 years old suffering from depression accounted for 30.28% of the total population [5], which is noticeable.

Reasons for this phenomenon included the internal deviations in cognitive, behavioral, and emotional development and also the external environment [6]. Additionally, by the end of 2021, psychiatrists accounted for 1.49 percent of the total number of physicians in China [2], representing large needs but a few supplies of mental health practitioners [7]. Moreover, compared to other age groups, teenagers were more reluctant to receive physical professional assistance [8]. In order to deal with these problems, mental health-oriented chatbots may have the potential to offer timely and personalized interventions, providing individuals with timely access to both resources and support.

2.2. Existing chatbots

The chatbots currently used and focused on the psychological field mainly include Woebot, Replica, X2AI, and so on. In Figure 3, there are some social robots used in reviewed articles:(a) Paro, AIST (b) Haptic Creature, photo by Marin Dee (C) NAO, Aldebaran Robotics (d) Betty, and (e) CRECA. [9]

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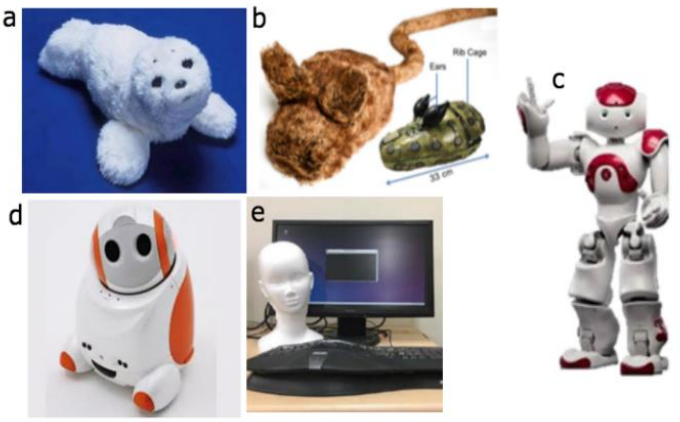

Figure 3: Social robots used in reviewed articles. [9]

(a) Parabots and (b) Haptic Creature: social human-robot interaction through affective touch. They are both a kind of interactive robot that's furry. Patients can stroke it to receive feedback, relieving their stress and burden. [10]

(c) NAO, (d)Betty, and (e) CRECA: traditional shaped interactive robots with hard outer skin. NAO can communicate with patients and CRECA listens to clients enabling them to gain a sense of identification [11][12].

2.3. Models applied to chatbots

A computational model of affective development was constructed according to the Transformer model, NLP model, and the Russian doll model of empathy and imitation (Figure 4).

The transformer model is a type of deep learning model, which can translate text and speech in near-real-time, enabling AI to predict the next word in a sequence of text. Besides, it has been the foundation of NLP [13]. The key to the Russian doll model is that the observer may have the same emotional state as the observed one, often known as 'Empathy' [14].

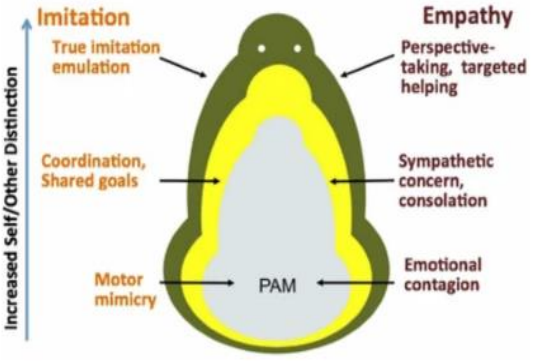

Figure 4: The Russian doll model of empathy and imitation. [14]

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2.4. Acceptability of chatbots

Interaction with social robots can release pressure and tension from people who do not suffer from social anxiety. Furthermore, it showed that individuals with social anxiety felt more relieved when they met with a robot than a human, which demonstrated the necessity for AI to solve psychological issues [15][16].

2.5. Limitations of current chatbots

However, computer simulation was difficult to implement with real robots [17] and the interaction quality of chatting text was not high. [18] In that case, chatbot screening more suitable chat content with higher quality to treat psychological problems in teenagers in China was critical and needed to be improved. Also, it has remained unknown whether the current robots meet teenagers' needs.

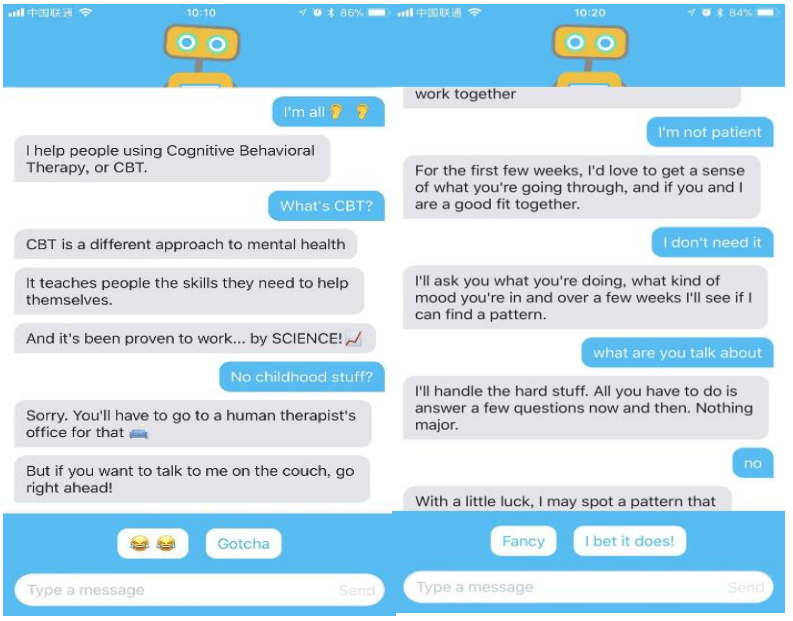

Figure 5: Screen of a chat history (Source: one of Zhihu's users)

AI technology held great promise to transform mental healthcare and did have a therapeutic effect on people suffering from mental disorders. However, due to its dehumanization and lack of intelligent algorithms, it performed poorly compared with real psychotherapists. In other words, more work should be done to fill the gap [19][20].

Figure 5 provides an example of the limitations of chatbot technology in addressing mental health concerns. In this example, it is obvious that AI's responses were so rigid and lacked human-like interactions that it might even irritate users and cause frustration [21], quite apart from curing. As such, it is essential to incorporate more emotional intelligence into chatbot design to ensure that users feel heard and understood.

2.6. Research aim

Although there are existing chatbots and technology, it is still unclear whether chatbots in digital mental health have been accepted by the Chinese and also whether and how they take effect. To shed light on these questions, this research conducted a quantitative analysis to solve these questions. By employing a quantitative approach, data were collected from a large sample size to provide robust and reliable insights. After that, policymakers and healthcare providers may make informed decisions

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regarding the implementation and optimization of chatbot technology in the Chinese mental health system.

3. Methodology

3.1. Research object

This research project focused on gathering data from individuals of different age groups in various regions of China, regardless of gender or occupation. To ensure a balanced representation of the population, the study aimed to recruit 100 male and 100 female participants. However, in practice, 103 males and 106 women were included. This slight deviation from the original target had less possibility to impact the overall results of the study since the difference is relatively small. Moreover, it can enhance the universality.

3.2. Collecting methods and procedures

In order to gather more objective answers to people's acceptance level of robots in digital mental health, which helps to find the possibility and potential of its application, a questionnaire containing a total of 16 questions was designed. In this questionnaire, participants were asked to select basic information, including gender, age group, and residential city, to ensure that the samples cover a comprehensive population, avoiding having too few samples that were one-sided. The questionnaire included single-choice questions, multiple-choice questions, fill-in-the-blanks, and scoring questions to gather more accurate data.

Through this questionnaire survey, the aim was to understand the public's awareness, willingness to use, and concerns regarding digital mental health robots. Moreover, the challenges and risk digital mental health robots may face in practical applications will be explored, providing valuable insights and guidance for developing digital mental health robots.

Questionnaires were distributed both online and offline. Through an online approach, a QR code was generated and forwarded with the help of an application called Sojump. Through an offline approach, questionnaires were distributed in the form of flyers. After that, a total of 209 questionnaires were collected.

3.3. Data analysis

The data was summarized and statistically analyzed through a software called Microsoft Excel. Based on the data typed into, the pie and bar charts could be formed, which were easy to analyze and compare.

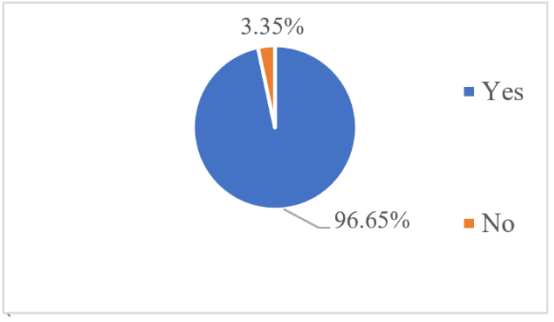

Figure 6: Whether people have ever heard of robots

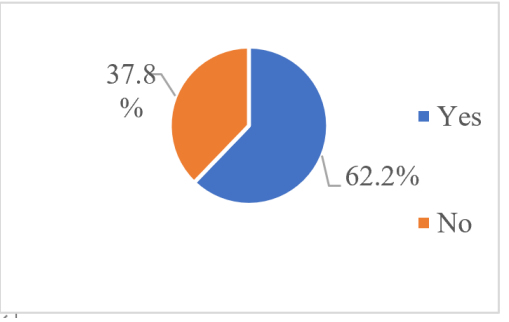

Figure 7: Whether people have ever heard of chatbots in mental health

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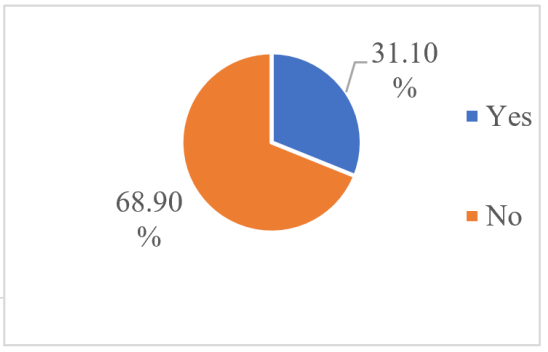

Figure 8: Whether people have ever used chatbots in mental health

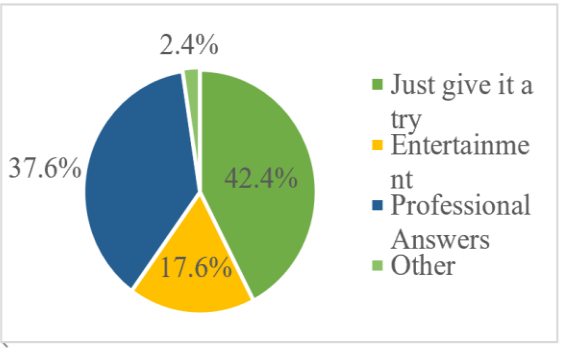

Figure 9: Purpose of use

Figure 6 shows the answer to the question 'Whether you have ever heard of robots?'. The total sample size is 209 and only 7 people (n=3.35%) chose 'No'.

Figure 7 shows the answer to the question 'Whether you have ever heard of chatbots in mental health?'. The total sample size is 209 and 130 people (n=62.2%) among them chose 'Yes'. It is clear that the percentage of 'Yes' has decreased significantly compared to the previous question, but it still accounts for the majority.

Figure 8 shows the answer to the question 'Whether you have ever used chatbots in mental health?'. The total sample size is 209 and only 65 people (n=31.1%) chose 'Yes'. It is clear that the percentage of 'Yes' has decreased dramatically compared to the previous question and it even accounts for a minority of them.

Figure 9 shows the answer to the question 'What was your purpose of use?'. The total sample size is 65 who have used chatbots in mental health. Most people (n=42.4%) chose 'Just give it a try'. Next, many people (n=37.6%) chose 'Professional Answers'. Subsequently, some people (n=17.6%) chose 'Entertainment'. The rest chose 'Other'. It showed that most people use it for non-professional purposes.

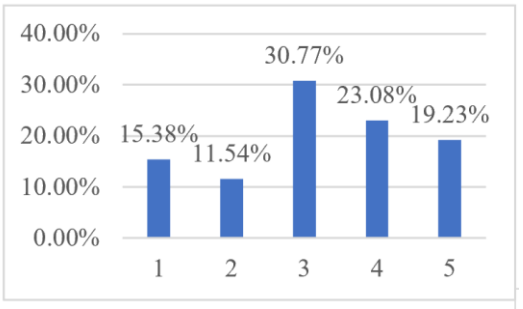

Figure 10: Rating of effectiveness

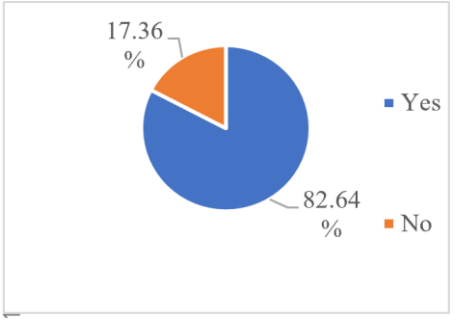

Figure 11: Whether people want to try to use it

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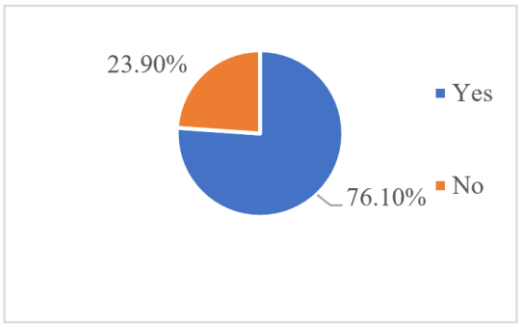

Figure 12: Whether people think telling to psychotherapeutic chatbots is more effective than speaking to others

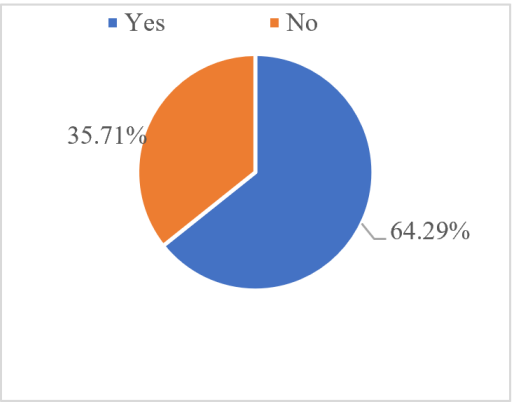

Figure 13: Whether people think telling to psychotherapeutic chatbots is more effective than digest alone

Figure 10 shows people's rating of effectiveness in using this kind of robot (Satisfaction increases sequentially from 1 to 5). The total sample size is 65 who have used chatbots in mental health. Most people (n=30.77%) gave 3 points, and next are 4, 5, 2, and 1 point, which represents good effectiveness.

Figure 11 shows the answer to the question 'Whether you want to try using it?'. The total sample size is 144 who have never used chatbots in mental health. 82.64 percent of them chose 'Yes'.

The question of question 12 is 'What will you choose when you feel bad?'. The total sample size is 209. 97 of them chose 'Speak to others', accounting for 46.41%. 112 of them chose 'Digest alone'. Accounting for 53.59%.

Figure 12 shows the answer to the question 'Whether you think talking to psychotherapeutic chatbots is more effective than speaking to others?'. The total sample size is 97 who chose to speak to others when feeling bad. 74 people of them (n=76.10%) chose 'Yes'.

Figure 13 shows the answer to the question 'Whether you think telling psychotherapeutic chatbots is more effective than digesting alone?'. The total sample size is 112 who chose to digest alone when feeling bad. 72 people of them (n=64.29%) chose 'Yes'.

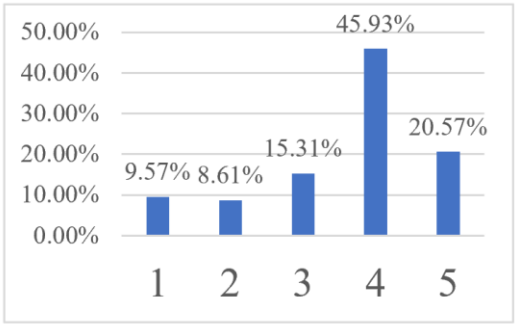

Figure 14: Rating of the prospects of psychotherapeutic chatbots in China according to intuition

序号 (Number)	答案文本 (Answer Text)
5	机器人不会像亲人朋友一样难以启齿，也类同于独自保密的消化，同时能有负能量输出，可减轻压力

(When confiding in a robot, it will not be as difficult to speak of as family and friends, and it is similar to digest alone. At the same time, it can embrace negative energy output, which can reduce stress.)

Figure 15: An explanation from one of the participants

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Figure 14 shows people's rating of the prospects of psychotherapeutic chatbots in China according to intuition (Satisfaction increases sequentially from 1 to 5). The total sample size is 209. Most people (n=45.93%) gave 4 points, and next were 5, 3, 1, and 2 points, which represents good hope.

In addition, there is an explanation for the participant's own rating of 4 points in Figure 15.

3.4. Moral considerations

Given the nature of this study, there are certain ethical considerations that should be taken into consideration. First and foremost, all the participants in this research were anonymous, and their privacy will be protected. In the questionnaire description, the confidentiality of the survey was clearly stated. Besides, they were treated with respect and courtesy and they agreed the data to be used for academic research purposes. Therefore, participants can rest assured that their personal information will not be leaked or abused.

4. Discussion

The results indicate that the popularity of chatbots in digital mental health has not been that high compared to other types of robots which are commonly known such as industrial robots (Figure 6 and Figure 7). Moreover, only a small number of people have come into contact with it (Figure 8), which demonstrates its unpopularity rate in China. However, both those who have used and those who have not, have shown reasonable expectations and aspirations for chatbots in digital mental health, possible reasons of which include curiosity towards new things and trust in the confidentiality of robots that differs from a real human. Furthermore, people's expectations of mental health care robots indirectly reflect their lack of emotional output, ccorresponding to Jin Xia's study.

Since China has such a market demand, scientists and producers can grasp it, optimize existing models that are applied to chatbots in digital mental health, and improve their performance of it. More importantly, it should be vigorously promoted to enhance its popularity to ensure that most people would be exposed to it.

It is essential to acknowledge that the sample size of 209 participants in this research project may not completely confirm the universality of the data due to its relatively small size. While a larger sample size would have been more ideal, recruiting such several participants can be challenging and resource-intensive. It should be noted that a sample size of 209 can still provide valuable insights into the acceptance and effectiveness of chatbots in digital mental health in China because it provides different representations of individuals from various age groups and regions.

The results of this study provide a preliminary understanding of the potential role of chatbots in digital mental health, particularly in the context of Chinese culture. Future research should seek to replicate and expand upon these findings with larger and more diverse samples in order to establish a more robust and generalizable evidence base. Additionally, further investigation into the factors that influence individuals' expectations and perceptions of chatbots in mental health care, such as cultural beliefs and attitudes towards technology, could help to inform the design and implementation of more effective and culturally appropriate chatbot interventions. This could ultimately contribute to improved mental health outcomes for Chinese individuals, as well as other cultural groups who may benefit from the use of chatbots in digital mental health.

5. Conclusions

This research aimed to discover the possibility (public acceptance and robots' effectiveness) of the application of chatbots in digital mental health in China. Based on a quantitative questionnaire and qualitative analysis, it can be concluded that people have a positive vision for the future of its application, although it is not so widespread, which indicates that the application of chatbots in digital

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mental health has potential development prospects. However, the current immature technology has resulted in a less than satisfactory user experience even though it can indeed help patients soothe their emotions as an outlet for emotions.

While the sample sizes of the questionnaire limit the generalizability of the results, this research provides new insight into Chinese people's views on this type of robot. To better understand the implications of these results, further research is needed to consider the causes behind people's opinions and how to further improve technology to enhance user experience. In addition, a combination of quantitative and qualitative methods can be considered to obtain more comprehensive research results.

References

[1] *Luo, Z.J., et al. (2023) 'Comparative analysis of mental health status of adolescents during COVID-19 epidemic', China Academic Journal Electronic Publishing House, 50(4).*

[2] *Xia, J. (2023) 'AI psychological service robots: helping people solve psychological problems on their own', China Academic Journal Electronic Publishing House.*

[3] *Wang, Y.J., et al. (2022) 'Research progress on adolescent mental health stigma', Chinese Journal of Health Education, 38(4).*

[4] *Cheng, H., et al. (2019) 'The rise of robots in China', Journal of Economic Perspective, 33(2), pp. 71-88.*

[5] *Jiang, X.H. & Zeng, Z. (2023) 'Trends of disease burden of depression in children and adolescents in China', Chinese Preventive Medicine, ISSN 1009-6639, CN 11-4529/R.*

[6] *Liu, C.R. (2023) 'Children with psychological illness need early treatment', China Academic Journal Electronic Publishing House, 12.*

[7] *Wang, Y.Z. (2023) 'The current situation and suggestions of mental health education for adolescents in China', China Academic Journal Electronic Publishing House.*

[8] *Wu, X.Y., et al. (2020) 'Status of stigma and its impact on compliance behavior and health status in adolescents with epilepsy', China Academic Journal Electronic Publishing House, 17(3).*

[9] *Scoglio, A.A. (2019) 'Use of social robots in mental health and Well-Being Research: Systematic Review', Journal of Medical Internet Research, 21(7), e13322. https://doi.org/10.2196/13322.*

[10] *Parorobots (no date) PARO Therapeutic robot. Available at: http://www.parorobots.com/ (Accessed: 25 December 2023).*

[11] *Kurashige, K., et al. (2018) 'Counseling robot implementation and evaluation', 2018 IEEE International Conference on Systems, Man, and Cybernetics (SMC), pp1716–1722.*

[12] *Aldebaran (no date) NAO. Available at: https://www.aldebaran.com/en/nao (Accessed: 25 December 2023).*

[13] *IBM (no date) What is a transformer model? Available at: https://www.ibm.com/topics/transformer-model (Accessed: 19 December 2023).*

[14] *de Waal, F. B. M. (2008). 'Putting the altruism back into altruism: the evolution of empathy', Annual Review of Psychology, 59, 279-300.*

[15] *Rasouli, S., Gupta, G., Nilsen, E. et al. 'Potential applications of social robots in Robot-Assisted interventions for social anxiety', Int J of Soc Robotics 14, 1–32 (2022). https://doi.org/10.1007/s12369-021-00851-0*

[16] *Nomura T, Kanda T, Suzuki T, Yamada S (2020) Do people with social anxiety feel anxious about interacting with a robot? AI & Soc 35:381–390*

[17] *Asada, M. Towards artificial empathy. Int J of Soc Robotics 7, 19–33 (2015). https://doi.org/10.1007/s12369-014-0253-z*

[18] *Yan, J. (2018) 'Research on the application of chatbot in the field of psychology', China Academic Journal Electronic Publishing House.*

[19] *Graham, S.A., et al. (2019) 'Artificial intelligence for mental health and mental illnesses: an Overview', Current Psychiatry Reports, 21(11). DOI:10.1007/s11920-019-1094-0*

[20] *Minerva F. & Giubilini A. (2023) 'Is AI the future of mental healthcare?'. Topoi: an international review of philosophy, 42(3).*

[21] *Eliane M., et al. (2021) 'Artificially intelligent chatbots in digital mental health interventions: a review', Expert Review of Medical Device. DOI: 10.1080/17434440.2021.2013200*