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The Evolution of AI Assistants of Virtual Agents to Emotional Intelligence

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ABSTRACT: This study provides an introduction to artificial intelligence, robotics, and research streams that examine the economic and organizational consequences of these and related technologies. The success of integrating AI into organizations critically depends on workers' trust in AI technology. This review explains how AI differs from other technologies and presents the existing empirical research on the determinants of human trust in AI, conducted in multiple disciplines over the last twenty years. Based on the reviewed literature, we identify the form of AI representation and the level of AI's machine intelligence as important antecedents to the development of trust and propose a framework that addresses the elements that shape users' cognitive and emotional trust. Our review reveals the important role of AI's tangibility, transparency, reliability and immediacy behaviors in developing cognitive trust, and the role of AI's anthropomorphism specifically for emotional trust. Conversely, those same applications can have humans who over rely on AI, acting as recommended by the systems with no criticism regarding the risks of a wrong decision. Therefore, there is an optimal balance with respect to trust in AI, achieved by calibration of expectations and capabilities. In this context, the literature about factors influencing trust in AI and its calibration is scattered among research fields, with no objective summaries of the overall evolution of the theme.

KEYWORDS: AI virtual assistants (AVA), artificial intelligence, robotics, framework, AI technology, AI's anthropomorphism.

I. INTRODUCTION

With the advancement of AI technology, there are increasing numbers of Artificial Intelligence (AI) applications, such as service robots, chatbots, and AI virtual assistants. Regarding AI virtual assistants, who can offer convenience and more efficient services to user's people's interest and frequency of use, is gradually increasing. Since technology acceptance is a key variable reflecting whether AI virtual assistants are accepted by users, it is important for product developers and corporate investors to explore the drivers of AI virtual assistant acceptance and their mechanisms of action. However, current research on the acceptance of AI virtual assistants still suffers from the following three deficiencies. First, the current studies focus more on the impact of functionality and social emotions than on the acceptance of AI virtual assistants (AVA), which helps reveal consumers' intention to use AI virtual assistants. However, the dual satisfaction of technical and social needs does not induce users to trust AI virtual assistants, which leads to low loyalty. In this case, it will be difficult for human users to collaborate with AI virtual assistants, thus limiting their application in society and making it difficult for AI virtual assistants to be truly accepted by human users. In fact, trust can reduce human users' negative emotions about and affect their tendency to accept new technologies. Consequently, the applicability of trust in the field of AI still needs further verification. Second, some scholars have tried to explore the potential mechanisms of users' trust in AI virtual assistants from the perspective of trust however, the relationship between trust and functionality and social emotions and whether the existing drivers have an impact on trust remain to be further explored. Finally, there is still a lack of effective transformation paths between AVA and their drivers, and it is unclear whether trust can carry the transformation between the two. This research scenario is not conducive to expanding the potential paths and intrinsic functions of AVA from a trust perspective. Second, trust building depends on the user's motivation and perception of using the AI virtual assistant, that is, it is affected by functionality and social emotion.

II. LITERATURE REVIEW

Schachner T (2020) A rising number of conversational agents or chatbots are equipped with artificial intelligence (AI) architecture. They are increasingly prevalent in health care applications such as those providing education and support to patients with chronic diseases, one of the leading causes of death in the 21st century. AI-based chatbots enable more effective and frequent interactions with such patients. The goal of this systematic literature review is to review the characteristics, health care conditions, and AI architectures of AI-based conversational agents designed specifically for chronic diseases. We conducted a systematic literature review using PubMed MEDLINE, EMBASE, PyscInfo,

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CINAHL, ACM Digital Library, ScienceDirect, and Web of Science. We applied a predefined search strategy using the terms "conversational agent," "healthcare," "artificial intelligence," and their synonyms.

Po-Sheng Chiu et al (2020) With the advent of the 5G and Artificial Intelligence of Things (AIoT) era, related technologies such as the Internet of Things, big data analysis, cloud applications, and artificial intelligence have brought broad prospects to many application fields, such as smart homes, autonomous vehicles, smart cities, healthcare, and smart campus. At present, most university campus app is presented in the form of static web pages or app menus. This study mainly developed a Deep Neural Network (DNN) based emotionally aware campus virtual assistant. The main contributions of this research are: This study introduces the Chinese Word Embedding to the robot dialogue system, effectively improving dialogue tolerance and semantic interpretation. The traditional method of emotion identification must first tokenize the Chinese sentence, analyze the clauses and part of speech, and capture the emotional keywords before being interpreted by the expert system.

Anita Williams Woolley (2020) Artificial Intelligence (AI) characterizes a new generation of technologies capable of interacting with the environment and aiming to simulate human intelligence. The success of integrating AI into organizations critically depends on workers' trust in AI technology. This review explains how AI differs from other technologies and presents the existing empirical research on the determinants of human trust in AI, conducted in multiple disciplines over the last twenty years. Based on the reviewed literature, we identify the form of AI representation and the level of AI's machine intelligence as important antecedents to the development of trust and propose a framework that addresses the elements that shape users' cognitive and emotional trust. Our review reveals the important role of AI's tangibility, transparency, reliability and immediacy behaviors in developing cognitive trust, and the role of AI's anthropomorphism specifically for emotional trust.

Iis Tussyadiah (2020) This research investigates travelers trust in intelligent autonomous technologies based on two studies involving self-driving transportation and robot bartenders. Targeting travelers residing in the United States, online questionnaires were distributed to test the relationships between trusting beliefs in intelligent robots, its antecedents, and its outcomes. The results demonstrate that the cognitive trust formation process holds in situations involving intelligent robots as objects of trust. Trust in intelligent machines is influenced by negative attitude toward technology and propensity to trust technology. Surprisingly, the physical form of robots does not affect trust. Finally, trust leads to adoption intention in both studies. The contribution of this research is in elucidating consumer trust in intelligent robots designed for socially-driven interactions in travel settings.

Ma, Xiaojuan (2019) An effective virtual agent (VA) that serves humans not only completes tasks efficaciously, but also manages its interpersonal relationships with users judiciously. Although past research has studied how agents apologize or seek help appropriately, there lacks a comprehensive study of how to design an emotionally intelligent (EI) virtual agent. In this paper, we propose to improve a VA's perceived EI by equipping it with personality-driven responsive expression of emotions. We conduct a within-subject experiment to verify this approach using a medical assistant VA. We ask participants to observe how the agent (displaying a dominant or submissive trait, or having no personality) handles user challenges when issuing reminders and rate its EI. Results show that simply being emotionally expressive is insufficient for suggesting VAs as fully emotionally intelligent.

Cause and Effect of EI in AI

A. Advantages and Disadvantages

Artificial intelligence itself is a high-level version of a human being which can bring many changes, with Emotional Intelligence being a part of Artificial Intelligence the scope of technology can raise to unpredictable states of advancements. Every field is now drawing themselves into Emotional Artificial Intelligence so that there can be increased levels of performance and stability. Some fields that portray this are Healthcare, Business, Consultation and more. There are many known and unknown advantages in the usage of Emotional Artificial Intelligence, one purpose would be emotional deduction, which is predicting the behavioral analysis of an individual and knowing how to react upon it. This is used mainly in the field of Education and Consultation as observing and analyzing one's behavior is important for creating conclusions and providing better suggestions to them. Another advantage would be, Emotional Artificial Intelligence can create multiple versions of itself to help increase the underlying jobs as well as helping out in the remote areas. In different parts of the world, things are situated and handled in different ways, there are many fair and unfair practices for all age groups.

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The Benefits of Emotionally Intelligent AI

Emotionally intelligent AI has the power to transform a vast range of industries by enabling more natural, meaningful interactions between humans and machines. In sectors from healthcare to education, emotionally aware AI systems that can perceive and simulate emotional states are demonstrating immense potential. These seemingly emotional AI applications facilitate trust in consumers, something that is vital for the public acceptance of AI in industries. According to a 2023 Statista survey conducted with marketers in the United States, 73% of respondents indicated that they are using generative AI. Unfortunately, the public at large still does not entirely trust AI. A 2022 KPMG global survey revealed that 61% of respondents are either ambivalent or unwilling to trust AI.

The Challenges of Emotionally Intelligent AI

The use of new technology always comes with challenges, and brands may run into a number of them when implementing emotionally intelligent AI. Here are a few of the most common challenges they may face:

- **Data collection and privacy:** Emotionally intelligent AI needs to be trained on a large dataset of human emotions. This data can be difficult and expensive to collect, and there are privacy concerns associated with collecting and storing such data. As Wozniak asked, “Are people okay with their emotional responses being tracked and analyzed for marketing purposes?”
- **Bias:** Emotionally intelligent AI can be biased, just like other AI systems. This bias can be caused by the data that the AI is trained on, or by the way that the AI is designed. It is important to be aware of the potential for bias and to take steps to eliminate it.
- **Ethics:** There are a number of ethical considerations that brands need to be aware of when using emotionally intelligent AI. How can brands ensure that it is used in a fair and responsible manner? “Is using AI to evoke specific emotions in consumers manipulative or deceptive,” asked Wozniak?

The Future of Emotionally Intelligent AI

In the future, emotionally intelligent AI is likely to be used in a wide range of applications, including healthcare, education, human resources, customer service and entertainment. For example, it could be used to develop new diagnostic tools and treatment plans in healthcare, personalize learning experiences in education, and improve employee recruitment and retention in human resources.

The future promises AI caregivers that uplift patients through dark times with compassion, AI teachers that nurture student growth by adapting to their emotional needs, AI assistants that deliver relaxing rather than stressful user experiences, and more. The benefits run deep for consumers, employees and brands.

Emotionally intelligent AI also has the potential to help us to better understand and manage our own emotions, as well as to build stronger relationships with others. The technology could also help us to create more human-centered products and services, and to solve some of the world's most pressing problems.

III. RESEARCH METHODOLOGY

The research design of the present study is based on the understanding that because of paucity of the research on this topic it is descriptive in nature based on inferential quantitative research approach. The quantitative approach focuses on numerical data, providing a systematic means of assessing occurrences and their relationships. Additionally, the author ensured data rigor by evaluating the validity and reliability of measurement tools during the research process. Reliability and validity assessment ensure the quality and integrity of the instrument and survey data for further analysis. Descriptive research is those which are concerned with describing the characteristics of a particular individual or of a group. All the studies concerned with specific predictions and narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies. In descriptive research the pre planned statistical design is used for the analysis purpose, structured instruments are used for the collection of data and advanced decisions are been made about the operational procedures. Extensive literature surveys have provided the base for the identification of variables for the study. Stratified sampling technique was done at two levels firstly the total population was divided into two strata. Further sub stratification was done and three sub strata was formed which constitutes the employees working on top, middle and lower levels of management in various manufacturing and service sectors.

IV. RESULTS AND DISCUSSION

The Farnell Larker criteria require diagonal values to be greater than the corresponding values of rows and columns. Table 3 reveals that all diagonal values of the square root of the AVE satisfy this criterion. The HTMT values should be equal to or less than 0.85 and Table 1 indicates that all values are below this threshold. Moreover, self-loading values should be greater than cross-loading values for discriminant validity.

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Table 1: HTMT values

	Artificial intelligence	Decision making	Human laziness
Decision making	0.311		
Human laziness	0.787	0.338	
Safety & privacy	0.831	0.309	0.596

Demographic profile of the respondents displays the demographic characteristics of the respondents, consisting of 315 participants. Among them, 164 individuals (52.1%) identify as male, while 151 (47.9%) identify as female. The data was collected from various universities in Delhi and Fujairah. The table reveals that 173 students (54.9%) are from Delhi, whereas 142 (45.1%) are from Fujairah.

Regarding age distribution, the students are categorized into three groups: <20 years, 20–25 years, and 26 years and above. Most students, 134 (47.1%), fall into the 20–25 years age group, while 71 students (22.3%) are below 20 years old, and 110 students (38.6%) are 26 years and above.

The final section of the table presents the academic programs of the students. It indicates that 164 students (52.2%) are pursuing undergraduate studies, 106 students (41.8%) are enrolled in graduate programs, and 45 students (14%) are pursuing postgraduate studies.

Table 2: Demographic distribution of respondents

	No.	Percentage
Gender		
Male	164	52.1
Female	151	47.9
Total	315	100
Cities		
Delhi	173	54.9
Fujairah	142	45.1
Total	315	100
Age group		
<20 years	71	22.3
20–25 years	134	47.1
26 years and above	110	38.6
Total	315	100
Program of study		
Undergraduate	164	52.2
Graduate	106	41.8
Post-Graduate	45	14.0
Total	315	100
The above is the demographic distribution of the data collected by students from different Delhi and Fujairah universities.		

Structural model: The structural model explains the relationships among study variables.

Regression analysis: Table 3 presents the results of the regression analysis, indicating the direct relationships within the model.

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Table 3: Regression analysis

Relationships	*t* values	*P*-values	Remarks
Artificial intelligence → Decision making	5.056	0.000	Supported
Artificial intelligence → Human laziness	23.275	0.000	Supported
Artificial intelligence → Safety & privacy	17.169	0.000	Supported
All three relationships in this table are based on the hypothesis of this study and all are statistically significant.			

The first direct relationship is between artificial intelligence and the loss in human decision-making, with a beta value of 0.256. This means that a one-unit increase in artificial intelligence results in a 0.256-unit decrease in human decision-making among university students in Delhi and Fujairah. The t-value for this relationship is 5.056, exceeding the threshold value of 1.89, and the p-value is 0.000, which is less than 0.05, indicating statistical significance. The second relationship is between artificial intelligence and human laziness. The beta value for this relationship is 0.689, indicating that a one-unit increase in artificial intelligence leads to a 0.689-unit increase in laziness among students from universities in Delhi and Fujairah. The t-value for this relationship is 23.275, surpassing the threshold value of 1.89, and the p-value is 0.000, lower than 0.05, demonstrating statistical significance

V. CONCLUSION

The use of Emotional Artificial Intelligence gives a much more profound view on how machines can help humans compared to the traditional ways of AI today. The importance of AI in education cannot be overstated. While technology provides multiple benefits and assists in a variety of academic and administrative chores, it also raises concerns about the loss of decisionmaking abilities, laziness, and security problems. Traditional AI uses logic and efficiency to solve and master solutions in small amounts of time on a particular field of study, such as dealing with mathematical calculations in scientific fields. AI technology aids decision-making assists teachers and students in completing tasks and streamlines various activities. However, these difficulties are being exacerbated by the increased acceptance and dependence on AI in the education sector. If we implement Emotional Intelligence in AI, the technology can widespread into new areas of studies. Many areas can be uncovered like; Healthcare, Education, Consultation, even in Construction. The scientific literature on trust in automation goes far back in the past, but has recently evolved to investigate trust in AI. With the growing inclusion of intelligent autonomous agents in modern society, it is necessary to understand when AI based systems should be trusted and when to question their recommendations and override their actions. Understanding trust involves proposing models based on factors that influence human trust in general. Therefore, this review brings studies with different proposals. And most of the existing proposals are qualitative and not readily deployable or testable.

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