



# AI Application in Psychology: A Literature Review

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## Abstract

Along with the high-speed development and broad application of AI, computer technology has entered into the new information technology generation, Intelligent Technology Era, which features in AI. This article analyzes the development history of AI application in psychology, as well as the prospect of future development. It is important that we get to know about and master the research and progress of AI in the field of psychology. Thus, we can get insights into the future and seize the future.

**Keywords:** Artificial Intelligence; Applications; Psychology; AI

## Introduction

In fact, Artificial Intelligence (AI) and psychology have always been two closely related disciplines. Since the concept of artificial intelligence was proposed 61 years ago, psychologists have been deeply involved in artificial intelligence research for a long time. Herbert A. Simon, the early pioneer of artificial intelligence, is a well-known crossover scholar. He combined cognitive psychology and computer science to produce the new discipline of artificial intelligence and is known as the “father of artificial intelligence.” In 1955, Herbert A. Simon successfully developed a “logical reasoner” that used machines to perform artificial reasoning. A few years later, he cooperated with Newell to develop a “general solver”, which could continuously judge the distance between the current state and the target state. To achieve the goal by feedback, this feedback mechanism is designed based on the way of thinking of human beings and provides concrete application examples for the computer to simulate the thinking activities of human beings [1]. Behavior can be divided into three levels: the easiest to imitate is skill behavior, such as riding a bicycle. The more advanced is rule-based behavior, such as “stop at the red light, go green” behavior pattern, and many artificial intelligence machines currently embody this level of behavior. There is an “expert system” for diagnosing the disease. It uses an inverted tree structure to first distinguish the patient’s gender, and then to distinguish the disease in detail from the shallower to the deeper, and decide the next operation based on the different conclusions drawn. The highest level of behavior has no rules to follow. It is the most difficult for humans and computers [2]. The current problems facing the artificial intelligence community the knowledge mining of artificial intelligence machines, the emotional response of artificial intelligence machines, and the

decision-making in a fuzzy state, all rely on breakthroughs in the corresponding aspects of psychology [3].

## Artificial Intelligence and Psychology

As an engineering discipline, the objective of AI is to enable computers to perform such intellectual tasks as decision making, problem solving, perception, understanding human communication, and the like. Accuracy, efficiency, flexibility, and reliability are the primary criteria of success for such systems, and information about human performance seems to be neither necessary nor desirable [4]. Now, humans have made great progress in various fields such as cognitive psychology, neuroscience, quantum physics, and brain science, and theories related to artificial intelligence have kept emerging. Without the integrated development of computer science with brain science, neuropsychology, linguistics, and other disciplines, the research and development of AI would not have made such great achievements [5]. Perhaps a part of the reason for AI’s early disinterest in human studies was the indecisiveness for the full-fledged assimilation of psychology to underscore discrepancy in the constitution of intelligence. Gallente’s remarks were confirmed by the geometric theorem proving procedure [6]. The development process of artificial intelligence is a process in which machines continue to replace people. In human history, the earliest use of robotic arms was to replace humans for physical labor, and then gradually transitioned to the use of machines for thinking, which is the origin of artificial intelligence. Scientist Turing gave an interesting example: if you talk to a machine through a barrier, you cannot tell whether you are talking to a machine or a human, and the machine has reached the stage of artificial intelligence [7].

In the final analysis, the thinking of machines is to imitate the thinking mode of human beings. It is the essential attribute of human beings that "thinking" has made artificial intelligence and psychology closely linked from the beginning. Psychology studies the input, output, storage and processing of information in the human brain, and studies the functions of various parts of the human brain. Many of its principles support the early procedures of artificial intelligence. The earliest dual-core computers imitated the human left and right brains, and designed chips responsible for different functions based on the principle that different areas of the human brain are responsible for different functions [8]. With this as the starting point, psychologists and computer scholars further cooperate to research and develop artificial intelligence by studying the methods of human problem-solving. With the development of artificial intelligence, the required functions have become more and more complex, but the most basic way is logical reasoning and induction, which is the professional field of psychologists and logicians. Psychologists provide basic principles and principles for artificial intelligence by researching and exploring the way of human logical thinking.

## A Precision of Task Definition and Description

So far, we have been proceeding just as we have a firm and precise grasp of the nature of AI. AI workers build and report systems that utilize processes, to which they refer as thinking, reasoning, decision-making, concept-formation, problem-solving, planning, and so forth [9]. Artificial intelligence (AI) research is mostly aimed at the design of systems that can perform tasks that currently require human intelligence. AI systems interact with "environments" that contain all relevant existing objects and the rules by which they interact, while "tasks" assigned to an agent describe (un)desirable environment states that should be brought about or avoided [10]. Specialized AI systems are often made with a single task in mind, while systems aspiring to artificial general intelligence (AGI) aim to tackle a wide range of tasks that are largely unknown at design time. Tasks can be divided into different sets of subtasks in various ways, and intelligent systems must make a choice about what tasks to pursue. AI workers are fond of using psychological terms to associate their programs to aspects of human cognition explicitly and thereby offering a pre-established theoretical framework [11].

## Information Technology and Psychology

The distinction between AI as an engineering discipline and AI as a science discipline is conducted in the light of the methods employed, rather than in the perspective of the tasks employed. If we look at artificial intelligence from the perspective of engineering technology, then cognitive science, especially cognitive psychology and neurophysiology, it does not need to be a prerequisite for the realization of artificial intelligence. On the contrary, if it is from a scientific perspective, we need to take the epistemological goal of cognitive science for biological intelligence as a prerequisite for the realization of artificial intelligence. The strongest engineering

viewpoint does not necessarily use computer as an implementation tool. On the contrary, the strongest scientific viewpoint believes that it is not a true artificial intelligence, as long as an intelligent machine is not based on the principles of human cognition. There is no conclusion in this debate so far [12]. However, commonalities between these two domains cannot be negated. The cognitive approach is a crossing point in psychology. Within this domain, applicability involves a simulation-based environment learning, computer-based emotion recognition, intra-group social interaction simulations, cognitive-behavioral therapies, computer-based psychiatric therapy, electronic inquiries as well as automatic output generation, and so on.

The findings of National Institute for Health and Care Excellence (NICE) regarding the IT applicability in cognitive behavior therapy has yielded promising outcomes. Psychoinformatics, born in response to the characteristics of the times and subject development, is a new subject in which psychology researchers actively try to use computer and information science technology to obtain, organize and analyze psychology research materials. Existing studies have shown that Psychoinformatics can not only help researchers verify the hypotheses of classic psychology from a new perspective, but also show great potential in exploring new psychological and behavioral laws of individuals and groups [13]. Whether using the Internet as a platform to conduct surveys and experiments or using mobile devices to collect various types of psychological behavior data, or even directly grabbing online ecological data information, the quantity and quality of psychology research data has been greatly improved. In order to significantly improve academic interest in data collection and analysis, psychology researchers are actively constructing databases and data classification systems that can be shared and reused in many branch research fields, so as to iteratively reorganize and integrate the multi-source data of branch research fields and even the entire subject. The development of computer and information science technology has brought psychology not only the capture of massive social and ecological data, but also a revolution in analysis tools and technology. On the one hand, various open-source statistical modeling software, such as R software, and network analysis software, such as Ucinet, KrackPlot, Negopy, etc., have made many analyses possible, and promoted relevant research process. On the other hand, as the core technology of psychoinformatics data analysis, the gradual infiltration of computer data mining technology has virtually promoted the development of exploratory research in psychology and supplemented the research logic of traditional psychology with hypothesis verification as the main feature. It helps to generate new hypotheses and theories [14].

## Applications in Psychology

Since the concept of artificial intelligence was proposed in 1956, psychologists and artificial intelligence researchers have conducted a lot of collaborative research. For example, in May 2018, the British journal Nature published a research result jointly completed by neuroscientists at the University of London and artificial

intelligence researchers from the DeepMind team in the UK. They used deep learning technology to successfully simulate the spatial navigation capabilities of the human brain. This kind of research shows the application prospects of artificial intelligence technology in psychology research [15]. Interactive Evolutionary Computation (IEC) is an algorithm in the field of artificial intelligence. It is an intelligent calculation method that organically combines human intelligence evaluation with evolutionary computers. At present, interactive evolutionary computation is well applied in the research of psychometric field. Japanese scholar Hideyuki Takagi and others applied interactive evolutionary computing to the psychological measurement and evaluation of patients with schizophrenia to assist in verifying that "the dynamic range of emotional expression felt by patients with schizophrenia is higher than that perceived by healthy people" [16]. This research is one of the pioneering studies of IEC applied to the field of psychometrics. Prior to this, psychiatrists and psychotherapists believed that patients with schizophrenia had problems with emotional expression, but due to the lack of quantitative methods to measure their emotional expression ability, they could not be used as a diagnostic basis. Interactive evolutionary computing provides a quantitative measurement method that makes it possible to measure the range of emotion perception. Later, Yan Zhang and others used interactive evolutionary computing technology to study the high social anxiety and low social anxiety college students, and successfully measured and compared the difference in the dynamic perception range of facial emotion recognition between the two. These studies show that interactive evolutionary computing, as an intelligent algorithm, is suitable for mental health measurement [17].

In recent years, facial expression recognition technology in artificial intelligence technology has been used in the research of psychological personality prediction. In the past, the method of determining the Big Five personality types was mainly questionnaire measurement, but it took a lot of time. Mihai Gavrilescu established a new non-invasive system in 2015 that could determine the person's Big Five personality characteristics based on the facial features obtained by facial motion coding [18]. Later, Gavrilescu and Nicolae Vizireanu proposed a facial feature analysis system based on a facial action coding system in 2017 to predict people's 16PF personality characteristics. The system could accurately predict the individual's 16PF personality within one minute, which is faster and more practical than the 16PF personality questionnaire and is suitable for predicting the personality characteristics of a person in a short time [19]. In addition to the prediction of personality scales, artificial neural networks (ANN), quasi-optimal Bayesian learners and support vector regression machines (SVR) of artificial intelligence technology are also used in psychological research to predict the cognitive and mental health of individuals. The processing process of human social cognition is similar to the information processing process of artificial neural network. Therefore, many researchers have established artificial neural network prediction models with their own characteristics for some psychological variables in the social cognition process. In addition,

artificial neural network technology has also been better used in mental health prediction. For example, Alessandro Serretti and others applied artificial neural network technology to successfully predict depression in clinical mood disorders [20]. The quasi-optimal Bayesian learner can simulate the changes of people's behaviors and beliefs in a constantly changing environment. Matilde M. Vaghi and others compared the data simulated by the quasi-optimal Bayesian learner with the behavioral data of obsessive-compulsive disorder and healthy people to explore how their behaviors and beliefs change over time. At the same time, they used different parameters in the Bayesian learning model as predictors to quantify and compare the differences in behavior and belief performance between patients with obsessive-compulsive disorder and healthy people [21].

Support vector regression machine is a new and effective machine learning method developed on the basis of computer statistical learning theory. Its principle is similar to artificial neural network. Compared with artificial neural networks, support vector regression machines can overcome the limitations of the former's use of large sample sampling requirements. Some researchers use support vector regression technology to predict the psychological characteristics of the research objects [22]. For example, Xinyin Huang and others used support vector regression technology to use the recognition rate of facial expressions in high and low trait anxiety groups to successfully predict their trait anxiety scores. Neural network technology is one of the technologies in the field of artificial intelligence. Bingmei Chen and others developed a set of children's psychological disorders diagnosis system using neural network technology. This system can diagnose more than 95% of children's psychological disorders, including 17 categories and 61 common children's psychological disorders, such as ADHD, conduct disorders, and mental disorders. In addition, the diagnosis system can also put forward treatment suggestions for each obstacle [23]. Expression recognition technology and voice detection technology have also been widely used in the recognition and diagnosis of psychological symptoms. In 2014, Asim Jan et al. developed an automated recognition system to calculate the scores of their Baker Depression Scale by extracting the natural facial expression features of depression patients in 2014 to assist in the diagnosis of depression; Jeffrey F. Cohn and others used facial recognition and voice detection technology to automatically identify depression. In addition, in 2017, Jane and others proposed an artificial intelligence system to assist in the diagnosis of depression. This system can calculate the score of their Baker Depression Scale through changes in individual voice and facial expressions.

There are also some studies using action recognition technology or a combination of expression recognition and action recognition technology to identify psychological symptoms. Sharifa Alghowinem and others have used video recordings of depression clinical interviews conducted in Australia, the United States, and Germany to identify depression by extracting the participant's gaze and head posture information. In addition, some researchers

have incorporated gestures and body movements into the analysis and recognition system. Jyoti Joshi and others have extracted and analyzed the facial expressions, gestures, and head movements of depression patients and normal individuals in interview videos for automated depression recognition. Shyam Sundar Rajagopalan and others have collected and annotated a set of children's self-stimulation behavior video data sets in the natural environment. This data set can be used as a good reference benchmark to identify children's self in daily activities. Stimulating behavior and assisting in the development of early diagnosis and intervention techniques can promote diagnosis and care by clinicians, parents and caregivers. At present, in the research on the application of artificial intelligence technology in the recognition and diagnosis of psychological symptoms, a variety of models combining visual and auditory models, as well as various information fusions such as facial expression and body movement information fusion, are used to carry out psychological symptoms. The identification and diagnosis have begun to bear fruit.

## An Information Retrieval System

Information Retrieval System (IRS) is often defined as the location and delivery of documents to a user to satisfy their information needs. IR is the area of study concerned with searching for documents, for information within documents, and for metadata about documents, as well as that of searching structured storage, relational databases, and the worldwide web. There is an overlap in the usage of the terms data retrieval, document retrieval, information retrieval, and text retrieval. IR is interdisciplinary based on computer science, mathematics, library science, information science, information architecture, cognitive psychology, linguistics, statistics and law. Automated information retrieval systems are used to reduce what has been called information overload. Psychologists distinguish information that is available in memory from that which is accessible (Tulving & Pearlstone, 1966). Available information is the information that is stored in memory—but precisely how much and what types are stored cannot be known. That is, all we can know is the information we can retrieve-accessible information. The assumption is that accessible information represents only a tiny slice of the information available in our brains. Most of us have had the experience of trying to remember some fact or event, giving up, and then—all of a sudden—it comes to us at a later time, even after we've stopped trying to remember it. Similarly, we all know the experience of failing to recall a fact, but then, if we are given several choices (as in a multiple-choice test), we are able to easily recognize it. When discussing the relationship between information retrieval (IR) and the psychological disciplines, it is necessary to bear in mind the historical dimensions leading to our present state of knowledge. Furthermore, other disciplines closely linked to psychology, such as linguistics, philosophy, epistemology and computer science, contribute valuable and applicable approaches for IR. This is a simple consequence of the fact that each single step in the IR process for the individuals involved (and system devices) is concerned with problem-solving and learning situations. Hence, the cognitive sciences—understood as an intersection of

linguistics, artificial intelligence (AI) and psychology—are of major importance to IR since they deal with problem-solving, perception, information processing psychology (IPP), conceptualization, thinking, etc. The Information Retrieval System (IRS) comprises data gathering, indexing, searching, and presentation. The data are gathered by retrieving information from the Internet or local networks as per the users set rules. Occasionally, it is applied as the solution of search by using independent units that will transfer the information to the central database. This case may require a data normalization process and some pre-indexing algorithms. In indexing, people look at the immediately searchable database. Although varied indexing approaches exist, the relevance of each depends mostly on the data size. Therefore, a traditional DataBase Management System (DBMS) is used to store data. In searching, a dedicated set of AI-based operations are used for each implicit DBMS users. In the presentation, graphical user interface employed in graphical data representation is made; clustering methods are also used. Cyberpsychology is a related research field still in infancy with unlimited potential because of the high speed of technological development [24].

## Psychotherapy and AI Alignment

Brief Psychotherapy assists patients to become aware of and change their behavior when facing an immediate emotional conflict, and to implement a transformation process through actions of listening, observing, increasing awareness and making interventions. Therapeutic work employs tools and techniques to trigger a process of change, emphasizing cognitive and emotional understanding. Regarding this perspective, Psychology can find in Computation support for very specific tasks. Currently, methods that provide support are easily found in Psychology, such as the cathartic method, the free association method and the psychoanalytic research method. The main concern of psychological therapy is to help the individual build self-awareness, that is, to raise its level of awareness about the condition it is going through. In the case of Psychoanalysis, the approach is to listen, observe and raise mindedness of the individual without the implementation of actions of intervention. Brief Psychotherapy, in turn, also listens, observes and raises awareness, but it also performs intervention by providing new information to the patient's hitherto old views and behaviors. In addition, psychological therapy is also constrained by problems related to the economic use of resources. There are circumstantial inhibitors for many people who seek help: the value of several sessions and the time of travel to the appointment location, for example.

The process of familiarizing with the patient involves the designing of mental models based on the small bits of available information. AI prioritizes the modeling of knowledge since understanding human behavior is integral for the machine to imitate. Knowledge Geometry is the computer-designed model of representation based on concepts (intuition) and vice versa (reification). Professional psychotherapy assesses the patient's behavior patterns, map them out under clear conditions, and

subject them to brief psychotherapy. The theoretical concepts of psychotherapy are applied in cases, where conflicts arise between the prepared psychotherapy maps and the individual in question. The reification operation is a process of inference, where analogies and isomorphism database are used as a resource. By analyzing each process and family pattern, it can be cross-examined, and novel methods can be devised for the system. The mechanisms of feedback and maintenance do not allow the system to obtain newer experiences and learning, thereby hindering its development or solving the conflict in question. This is referred to as case-based reasoning and is done by first-order logic. While the psychotherapist tries to simplify the patient's symptom and associate it to the broader interactional system and link it to the global scenario, it reflects the intuition operation of Knowledge Geometry. This particular phenomenon is later applied as ancillary support for understanding a broader pattern in this case; AI calls a process akin to machine learning. The systemic-linking method is a step forward in the application of computational intelligence as an auxiliary tool in evaluating the behavioral pattern of couples, families, and individuals. Among the numerous strategies of AI, first-order logic, automatic theorem prover, and fuzzy logic can be used to match the associated psychotherapy interventions linked to the characterization of essential areas, genogram creation, self-determination assessment, cognitive interaction pattern testing, improved self-awareness, and modifications [24,25]. Despite these developments, the opinion that AI investigations have not yet evolved as a universal method for sophisticated formulation of problems needs not be overlooked [26].

## Discussion

The development of artificial intelligence and related technologies has provided breakthrough research methods and tools for psychological research. The application of psychological research results to brain mechanisms in the field of artificial intelligence has also promoted the progress of artificial intelligence research. By combining the latest research results in the two fields of artificial intelligence and psychology for cross-research, the scientific problems of these two disciplines can be better solved. These two disciplines will also promote each other's development through mutual integration and enhance their social application value. As with any emerging technology, vigilance must be used cautiously to overcome optimism bias, primarily to serve the best interests of the people, for whom the technology is designed to help. Not to mention that AI is here to stay, further emphasizing that the organization must stay attuned to the economic and social changes of the society; otherwise, it will fade away. Nevertheless, psychology will always be a constant source of help to individuals struggling with insecurities and societal adjustments. Moreover, the advanced technological development has not in any way altered the mutual stimulus established by the interaction between the patient and the therapist. Technological advancements influence psychologists in many ways; however, the effect of the advancement in technology on psychology is associated with its own set of positive and

negative aspects, for which clinicians, therapists, counselors, and researchers must be well-equipped to handle.

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