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Research Article

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The Impact of AI Empathy Perception on Warmth: The Moderating Effect of AI Anthropomorphism

Yige Wu

Henan Polytechnic University, School of Business Administration, Jiaozuo, China
wyg9999992023@163.com

Abstract: With the continuous development of algorithms and deep learning, artificial intelligence emotion computing, through deep integration of multiple disciplines, is gradually acquiring emotional expression abilities similar to those of humans, including observation, understanding, and reaction. According to social cognitive theory, in the context of AI team members integrating into organizations, warmth refers to the perceived goodwill or malice of AI team members towards their human counterparts. To further explore how human team members' empathy perception of AI members influences their perception of warmth towards AI, this study constructs a hypothetical model. Through empirical investigation, the study finds that AI empathy perception positively influences human employees' perception of warmth towards AI, fostering human-AI relationships in human-AI collaboration. AI anthropomorphism plays a moderating role in this process. Theoretically, this research further expands the application of empathy abilities and the warmth dimension of social cognitive theory; practically, it provides guidance for organizations in correctly managing the relationship between human employees and AI employees.

Keywords: artificial intelligence, empathy perception, AI anthropomorphism, warmth

1. Introduction

The phenomenon of artificial intelligence (AI) collaborating with human employees has become increasingly common, profoundly impacting management models, work structures, work roles, and organizational architecture changes. Thanks to its powerful learning and computational analysis capabilities, the role of AI has transitioned from providing simple technical support as an automation tool (passive object) to becoming an intelligent work partner (active individual) (Alan et al., 2023[1]; O'Neill et al., 2022[2]). Compared to previous technological transformations, AI-based algorithms possess complex interactive capabilities that fundamentally alter human employees' perceptions of work, social relationships within work, and the true meaning of "colleagues", often in dramatic ways (Tang et al., 2023[3]; Tang et al., 2023[4]). In the dimension of social perception, AI has started to engage in social interactions with humans, attempting to understand and mimic human emotional characteristics. It expresses warmth by understanding others' feelings, capturing care and friendliness, and taking on tasks that require warmth to some extent (Fiske et al., 2007[5]; Gelbrich et al., 2021[6]; Peng et al., 2022[7]). As a partner that can provide both technical and emotional support (empathy and comfort) (Menon & Dubé, 2007)[8], social-emotional AI has drawn widespread attention from business managers. Therefore, this study analyzes how human employees' perceptions of AI empathy affect their perception of warmth, which helps in understanding human employees' attitudes toward AI colleagues. This foundation is crucial for better researching AI acceptance and achieving organizational utility maximization through deep collaboration with AI.

AI is endowed with empathy, allowing it to understand, perceive, and respond to human emotions and needs. AI empathy is a core manifestation of AI providing emotional support. Previous research has confirmed that AI empathy perception and warmth influence people's attitudes toward it (Xue et al., 2023)[9]. However, in the context of AI working alongside human team members, the role of AI empathy perception in shaping employees' warmth perception and its influencing factors remains unclear and fragmented. Previous scholars have not addressed the following questions: Can humans perceive warmth after AI exhibits empathetic behavior? Do AI's anthropomorphic features have an impact in this process? The key question of this study can be interpreted as follows: The introduction of AI into the workplace may bring changes to an increasing number of human employees. Therefore, business managers aim to improve work efficiency by using AI. However, due to stereotypes, people often perceive AI as impersonal and tend to overlook its social presence. This seems to pose a significant challenge for managers and developers. When designing AI personas and applications, in addition to efficiency-driven capabilities, what impact will endowing AI colleagues with appropriate anthropomorphic features and social-emotional expressions have on human employees' social cognition? This study combines AI's empathetic abilities with anthropomorphic technology to explore the impact on employees' perception of warmth.

First, this study utilized existing literature to identify a positive correlation between AI empathy perception and warmth perception from a social cognition perspective. Second, it explored the moderating effect of AI anthropomorphism and further verified and deepened this theoretical framework. The study primarily employed multilevel regression analysis and structural equation modeling (SEM) to test the entire theoretical model and research variables. Data analysis was conducted using statistical software such as SPSS 26.0 and AMOS 24.0. Finally, based on the results of the data analysis, hypotheses were validated, and conclusions were drawn from this study.

2. Literature Review and Hypothesis Deduction

AI empathy perception

Empathy is a complex process involving human emotions and cognition. With the development of AI, researchers have begun exploring how to enhance AI's empathetic capabilities. Analyzing existing literature reveals that research on AI empathy may require the integration of multiple interdisciplinary fields, such as information systems, human-computer interaction, psychology, cognitive neuroscience, marketing, and management, based on the findings from these disciplines (Lim et al., 2022[10]; Pentina et al., 2023[11]). In organizations where AI works alongside humans, AI can perceive empathy by mimicking human emotional recognition and response abilities. It can provide emotional support and cognitive assistance to employees when appropriate. For example, when human employees express negative emotions, or when AI identifies through voice or text that an employee is in an unpleasant situation, AI can "feel" compassion and sadness according to the employee's emotional state. It can then adjust its responses by offering comfort, companionship, and advice. Conversely, when AI recognizes positive emotions in humans, it can "feel" happiness and pride (Gelbrich et al., 2021[12]; Ramadan et al., 2021[13]). AI empathy makes people feel understood and cared for.

The potential empathy of artificial intelligence could have subsequent effects on human decision-making, thinking, and behavior within human systems in the real world. For example, in AI service applications, enhanced empathy could increase service acceptance and user compliance (Yoon & Lee, 2021)[14]. However, the relationship between humans and artificial intelligence is not only related to AI's ability to truly understand, generate, and respond with empathy but also more importantly to how humans perceive AI's empathetic behavior (Pataranutaporn et al., 2023)[15]. Human experiences and feelings are closely related to the understanding and response of the social groups they belong to regarding AI. Previous research has shown that, in addition to the efficiency and appeal brought by AI, social groups play a similarly important role in influencing the acceptance of AI by interacting individuals (Kim & Baek, 2018[16]; Pelau et al., 2021[17]). From the current societal attitude toward AI, it is unlikely that AI can be completely regarded as an equal social role to humans. However, according to the theory of computers as social actors, considering AI devices as social actors will lead to interactions similar to human-human interactions (Heerink et al., 2010)[18]. When human employees interact with AI, they may unconsciously anthropomorphize AI's empathy. In this context, how might human employees perceive AI's emotional behavior in the workplace?

Warmth

According to Fiske et al. (1999)[19], with the further development of social cognition theory, people primarily assess others' social cognition through two dimensions: warmth and competence. The first dimension, related to warmth, involves social traits such as tolerance, sincerity, kindness, and morality, and is mainly associated with perceptions of friendliness and helpfulness. The second dimension, related to competence, reflects traits such as skill, efficiency, physical strength, and intelligence, including ambition and competitiveness. In the field of social psychology, social cognition has been regarded as an alternative concept for social judgment. According to De Keyser and Kunz (2022)[20], after experiencing external environments or events, people evaluate: (1) whether the event meets their decision-making intentions, which translates into their perception of competence (i.e., whether it is influential, creative, and efficient); or (2) whether the event satisfies their need for friendliness in cooperation, which involves their perceived warmth (i.e., whether it is friendly and sincere). These cognitive patterns are referred to as stereotypes. It is important to note that when people lack sufficient information, they are likely to use stereotypes to judge the target. Similar to the research of El Hedhli et al. (2023)[21], according to the Stereotype Content Model (The Stereotype Content Model helps to analyze the perception and evaluation of different social groups), the two key dimensions for judging others, namely warmth and competence, almost entirely reflect the ways in which people evaluate different social groups. Specifically, warmth is related to how people perceive the positive or negative intentions of others; people usually consider those with good intentions to be trustworthy (Hu et al., 2021)[22]. Competence refers to a person's ability to handle affairs according to their own intentions; if a person is considered capable of fulfilling a certain role, they are regarded as competent (Cheng et al., 2022)[23].

In everyday work scenarios, the perception of warmth is crucial because such environments typically require a higher level of interpersonal skills, such as likability, social insight, social orientation, and active listening and communication abilities. Judgments about an individual's warmth are often made quickly and can significantly influence others' perceptions. Therefore, the warmth of colleagues, also referred to as politeness, civility, or employee likability, can be considered a precursor to interpersonal relationships (Belanche et al., 2021)[24]. For artificial intelligence, simple social behaviors, such as making eye contact or nodding to show attention, can enhance people's perceptions of its responsiveness and empathy (Broadbent et al., 2009)[25], indicating that a social connection has been established (Čaić et al., 2018)[26]. Social cognitive theory suggests that competence and warmth encompass nearly all social judgments people make. Perceived competence is closely related to cognitive evaluation, while perceived warmth is closely associated with emotional perception (Fiske et al., 2007)[27]. In artificial intelligence, cognitive tasks are executed by mimicking human intelligence, which corresponds to competence, while affective computing simulates emotional intelligence (Caruelle et al., 2022)[28]. Warmth is primarily associated with emotional intelligence (Kim et al., 2019)[29]. Recent applications of social cognitive theory and literature on emotional AI or intelligent personal assistants indicate that when forming attitudes or usage intentions toward AI, people evaluate its warmth or emotional intelligence (Belanche et al., 2021)[30].

AI anthropomorphism

Based on existing research, scholars define the anthropomorphism of artificial intelligence from three main perspectives: (1) Feature Attribution Perspective: Anthropomorphism is defined as attributing human characteristics, behaviors, or mental states to non-human entities (such as objects, brands, animals, and technological devices) (Epley et al., 2007)[31]. This includes not only physical features like appearance and expression but also human-specific mental traits such as reasoning, moral judgment, intention formation, and emotional experiences (Golossenko et al., 2020)[32]. (2) User Perception Perspective: Glikson and Woolley (2020)[33] define anthropomorphism as the perception that technology or objects possess human qualities. These perceptions may be driven by interface features and behavioral characteristics, such as a robot's humanoid form, gaze, and gestures. (3) Capability Perspective: Anthropomorphism is defined as the human tendency to attribute human-like abilities to robots or inanimate objects (Novak and Hoffman, 2019)[34]. In conclusion, there are different perspectives on anthropomorphism in current academic research, and there is no consensus on a unified definition of anthropomorphism in artificial intelligence. Given that anthropomorphic characteristics can enhance user trust and willingness to continue using AI (Wang et al., 2024)[35], they have a significant impact on human-computer interaction quality. Studies have shown that anthropomorphic design in

chatbots' appearance and communication style can increase their social presence, thereby influencing trust beliefs and user satisfaction (Andreas, 2023)[36]. Moreover, research by Pelau et al. (2021)[37] found that psychological anthropomorphic traits can enhance perceived empathy in AI devices and improve the quality of interactions between users and AI, thereby increasing people's acceptance and trust in AI devices in their daily lives. This article argues that the trust and acceptance factors brought by anthropomorphic design are related to the positive emotions of warmth and empathy that human employees perceive in AI. Anthropomorphism is a metaphorical expression of personification. In the fields of computer science and engineering, anthropomorphism is no longer limited to early developers borrowing psychological terms (such as the "memory" of computers) to describe computer phenomena and their operations. Anthropomorphism has become a major approach in human-computer interaction, which is clearly reflected in the design of robots and humanoid robots adopting anthropomorphic forms, as well as the design of anthropomorphic interfaces that facilitate social behavior and interaction between users and robots/computers (Wang, 2017)[38].

Anthropomorphism is considered an automatic psychological process; however, not everything is anthropomorphized by people, and not everyone anthropomorphizes to the same extent. To enhance the effectiveness of human-robot interaction, robots must be anthropomorphized to some degree (Zhang et al., 2022)[39]. Anthropomorphism includes not only physical features such as appearance, voice, expressions, and behaviors but also psychological traits. Appearance-based anthropomorphism is one of the most prominent and noticeable attributes of service robots, and it is the most intuitive anthropomorphic feature for users. When robots exhibit higher levels of social interaction behaviors, people tend to perceive them as more anthropomorphic, as social agents (Fraune et al., 2020)[40]. The theory of computers as social agents mentions that a robot's human-like voice is also an important social cue. With the deeper application of artificial intelligence technology, service robots are increasingly resembling humans emotionally and psychologically, demonstrating human personality traits such as extroversion and humor (Zhang et al., 2021)[41]. Humans possess various psychological abilities, and when evaluating whether robots resemble humans, they tend to differentiate between multiple dimensions of anthropomorphic traits (Kühne & Peter, 2023)[42], thereby forming an overall perception of anthropomorphism.

3. Theoretical Model and Hypothesis Derivation

The Impact of AI Empathy Perception on Warmth Perception

Empathy plays a central role in social interactions (such as prosocial behavior, inhibiting aggressive behavior, and externalizing problem behaviors), enabling us to interact effectively in society (Baron-Cohen & Wheelwright, 2004[43]; Guariglia et al., 2015[44]). In other words, AI empathy is a core expression of AI's emotional support for social interactions and warmth transmission. Whether scholars have discussed the perception of warmth (emotion) and ability towards AI, value co-creation in human-machine interaction, or human-machine symbiosis (McKee et al., 2023[45]; Xiang & Xu, 2023[46]), the underlying mechanism remains the influence of AI's introduction on people's attitudes and behaviors, which leads to a series of outcomes related to improving organizational performance through human-machine interaction. One of the most important design factors for successful human-machine interaction is how the characteristics of AI members affect human employees' acceptance of AI members. Research has found that when humanoid AI members are able to show empathy and interact with human consumers, their acceptance is higher. Additionally, human perceptions of AI as social agents can give them a sense of equality with humans, which in turn increases human acceptance of AI in various service contexts (Pelau et al., 2023)[47]. In other words, the perception of empathy towards AI increases human acceptance of it. Furthermore, two studies by Harris-Watson et al. (2023)[48] found that general dimensions of individual perception, such as warmth and competence, provide a particularly useful framework for understanding social perception of AI members. Their research showed that perceived warmth and competence both contribute to the acceptance of AI members. However, previous scholars have not fully elaborated on the underlying mechanism of how perceived warmth promotes acceptance of AI. Therefore, this study proposes:

Hypothesis 1: Perception of AI empathy positively promotes human employees' perception of warmth.

The moderating role of AI anthropomorphism

When people engage in smooth communication with AI, similar to interacting with a friend, they perceive AI as a social entity. Nass and Moon (2000)[49] argued that when humans interact with computers possessing human-like characteristics, they unconsciously respond in a socially oriented manner, using social responses such as politeness, self-disclosure, and trust. Additionally, Zheng et al. (2015)[50] suggested that anthropomorphized robots and smoother human-robot interactions help improve human subjective experiences. For example, in voice shopping, when consumers interact smoothly with an AI chatbot and the chatbot considers product recommendations from the consumer's perspective, consumers tend to view the AI chatbot as a friendly and sincere friend rather than just a cold, robotic entity. This leads consumers to feel warmth and goodwill towards the AI chatbot (Yang et al., 2024)[51]. When restaurant service robots with human-like characteristics can demonstrate a high level of empathy, users tend to have a higher sense of trust and acceptance toward them (Pelau et al., 2021)[52]. When social robots are capable of expressing empathy and sympathy, they become as popular as humans (Liu & Sundar, 2018)[53]. Therefore, when humans perceive AI as having emotions and being able to understand their feelings, they are more willing to form close companion relationships with AI. From a theoretical perspective, based on social cognition theory, AI anthropomorphism can enhance human perceptions of AI's warmth and competence, as long as it does not trigger the uncanny valley effect (Song et al., 2024)[54].

In real-world work environments, information technology can simulate more realistic social behaviors. The theory of computers as social actors suggests that human interaction with computers is similar to interaction with other humans. Humans unconsciously perceive and respond socially to technology, leading them to treat computers as if they were real people. As a result, people are more likely to interact with intelligent technologies that possess human-like characteristics. Although they consciously know that AI is not human, people still unconsciously perceive computers through anthropomorphic elements such as facial expressions, gestures, and eye contact, which increases their trust in AI technology (Xu et al., 2022)[55]. This, in turn, can enhance human-AI interaction. Specifically, compared to AI with lower levels of anthropomorphism, AI with higher levels of anthropomorphism can unconsciously increase human employees' trust and acceptance during their collaboration. Human employees are more likely to form closer relationships with such AI. Therefore, when human employees perceive the empathy of AI with a high level of anthropomorphism, they will experience greater warmth in their social responses. Based on the above arguments, this study proposes the following hypothesis:

Hypothesis 2: The anthropomorphic characteristics of AI will positively moderate the degree of warmth generated by AI's perceived empathy. The higher the level of anthropomorphism, the stronger the positive impact.

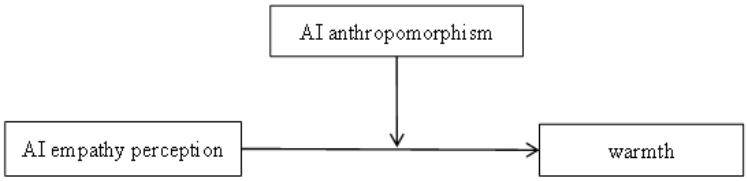

Figure 1: Theoretical Model

4. Methods

Participants and procedure

This study used an online questionnaire survey method to collect sample data. First, we contacted the HR managers of various companies to obtain their leaders' consent and support. Next, the questionnaires were distributed and collected online. The data collection period was from July 16, 2024, to August 16, 2024. The respondents were sales, research and development, administrative, production, and operations staff from five companies in China. Considering that the introduction of AI members with empathy is a relatively new and transformative organizational management strategy, it requires companies to have flexible management practices and a high level of digitalization. Therefore, the companies selected for the survey were mainly those

with advanced digital technology and the application of AI technology, and the respondents all had some degree of collaboration with AI in their work processes.

To ensure the validity of the data, this study adopted a time-segmented measurement method for data collection. The measurement time points were Time 1 (T1) and Time 2 (T2). At T1, data was collected on human employees' AI empathy perceptions, gender, age, years of work experience, education level, job type, and organizational attributes in organizations that had introduced empathetic AI members. A total of 400 questionnaires were distributed to employees from the five companies mentioned above. After excluding invalid responses (such as those failing screening questions and providing false answers), 389 valid questionnaires were collected, resulting in a valid response rate of 97.25%. Employee identification numbers and the last digits of their phone numbers were recorded at T1 to ensure accurate tracking of participants for subsequent data collection. One month later, at T2, measurements were taken on warmth and AI anthropomorphism. Questionnaires were distributed to the 389 individuals who had completed valid questionnaires at T1, and 368 valid responses were collected, resulting in a valid response rate of 94.60%. A total of 368 valid samples were obtained (59.8% female, 40.2% male; average age = 32.25, SD = 6.53; average years of work experience = 8.03, SD = 5.36), with an effective response rate of 92%. Among the respondents, the majority had a bachelor's degree (67.1%), followed by those with a master's degree (17.6%). Since the samples in this study were from companies with high levels of digital technology, and the data were collected from primary human employees who had contact with AI, their understanding and acceptance of this study were generally high.

Measures

The scale used in this study is sourced from mainstream international literature and has been confirmed to be locally applicable through our pre-test. We hired professors from the Foreign Language Institute and foreign experts to assist in the translation process: first, the English scale was translated using the backward translation method. Then, the Chinese scale was re-translated back into English using the interactive translation method. This process was repeated for several rounds of English-Chinese translation to ensure the integrity and fluency of the semantics, while also ensuring the scale meets academic standards. Finally, the scale was distributed to three companies that use empathetic AI members for pre-testing, and efforts were made to align the content of the questions with local language expressions. Apart from control variables, the manipulated variables were measured using a five-point Likert scale, where participants were asked to rate the descriptions of the questions according to their actual situation on a scale from 1 (strongly disagree) to 5 (strongly agree). Prior to measurement, we assured employees that the survey was anonymous, the results would only be used for academic research, and all information would be strictly confidential and not disclosed, so that employees could express their true feelings as openly as possible.

AI Empathy Perception: This was assessed using a five-item scale developed by Kellett et al. (2006)[56], and appropriately phrased according to the specific context. One of the items was: "Feels emotions that other people experience". The Cronbach's alpha was 0.841.

Warmth: This was assessed using a four-item scale adapted from Fiske et al. (2002)[57], and appropriately phrased according to the specific context. One of the items was: "As viewed by society, how warm are members of this group?". The Cronbach's alpha was 0.793.

AI Anthropomorphism: This was assessed using a five-item anthropomorphism questionnaire adapted from Bartneck et al. (2009)[58], and appropriately phrased according to the specific context. One of the items was: "AI are more humanlike and don't feel like a machine.". The Cronbach's alpha was 0.834.

Control Variables: To prevent the correlation between the manipulated variables from being affected by irrelevant variables, we controlled for demographic variables such as gender, age, years of work experience, and education level.

5. Results

Confirmatory factor analyses

This study used Amos 24.0 to conduct confirmatory factor analysis (CFA) to examine the discriminant validity of the variables. Using the three-factor model as a benchmark, two alternative models were constructed: the one-factor model (AI empathy perception + warmth + AI anthropomorphism) and the two-factor model (AI empathy perception + warmth, AI anthropomorphism). Table 1 presents the results of the confirmatory factor analysis.

The data analysis results indicated that the three-factor model had the best fit ($\chi^2/df = 2.000$, CFI = 0.966, TLI = 0.959, RMSEA = 0.052, SRMR = 0.039) compared to the other models, and all indices met the criteria, suggesting that the data structure has good discriminant validity.

To assess the potential impact of common method bias, this study referred to the study by Podsakoff et al. (2003)[59] and added a common method factor to the three-factor model structure to establish a four-factor model. The results in **Table 1** show that the model fit improved ($\chi^2/df = 1.638$, CFI = 0.983, TLI = 0.974, RMSEA = 0.042, SRMR = 0.025), indicating the presence of some degree of common method bias. However, the improvement in indices like CFI and RMSEA was limited, not exceeding 0.02, suggesting that common method bias does not pose a significant threat to the research results.

Table 1: Results of Confirmatory Factor Analyses

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	SRMR
1-factor model（AIEP+W+AIA）	444.315	77	5.770	0.833	0.802	0.114	0.072
2-factor model（AIEP+W、AIA）	258.293	76	3.399	0.917	0.901	0.081	0.053
3-factor model（AIEP、W、AIA）	147.982	74	2.000	0.966	0.959	0.052	0.039
4-factor model（3-factor +CMB）	98.291	60	1.638	0.983	0.974	0.042	0.025

Note: AI Empathy Perception=AIEP, Warmth=W, AI Anthropomorphism=AIA, Common Method Bias=CMB

Descriptive statistics

This study used SPSS 26.0 for descriptive statistics and correlation analysis, with the results shown in **Table 2**. AI empathy perception (x) was significantly positively correlated with employee warmth perception (y) ($r = 0.610$, $p < 0.01$). Additionally, the correlation coefficients between the manipulation variables were all less than 0.7. The statistical results provide preliminary support for Hypothesis 1.

Table 2: Means, Standard Deviations, and Correlation Matrix for Key Measures

variables	1	2	3	4	5	6	7
1 Gender	-						
2 Age	0.033	-					
3 Education	0.123*	-0.093	-				
4 Seniority	0.011	0.874**	-0.135**	-			
5 AI Empathy Perception	-0.078	0.112*	0.132*	0.143**	-		
6 Warmth	-0.062	0.054	0.086	0.073	0.610**	-	
7 AI Anthropomorphism	-0.130*	0.142**	0.038	0.148**	0.623**	0.528**	-
M	1.600	2.100	3.020	2.600	3.617	3.841	3.375
SD	0.491	1.000	0.666	1.277	0.795	0.721	0.833

Note： *p<0.05， **p<0.01

Hypothesis testing

This study used hierarchical regression analysis with SPSS 26.0 as the analysis tool to test the above hypotheses. The results of the hierarchical regression analysis are shown in Table 3. First, linear regression analysis was conducted using SPSS 26.0. As shown in Model 1 of Table 3, AI empathy perception had a significant positive effect on warmth perception ($\beta = 0.553$, $p < 0.001$). Therefore, Hypothesis 1 was further validated.

Table 3: Hierarchical Regression Results

Variables	Warmth			
	Model1		Model2	
	β	***s.e***	***β***	***s.e***
Intercept	1.877	0.214	3.793	0.405

Gender	-0.022	0.062	0.003	0.058
Age	-0.005	0.062	-0.027	0.057
Education	0.006	0.047	-0.006	0.043
Seniority	-0.004	0.049	-0.002	0.045
AI Empathy Perception	0.553***	0.039	-0.180	0.106
AI Anthropomorphism			-0.580***	0.134
AI Empathy Perception*AI Anthropomorphism			0.216***	0.035
R^2	0.373		0.467	
$\triangle R^2$	0.364		0.457	
F	43.087***		45.110***	

Note: ***P<0.001

Next, Model 2 in **Table 3** shows that the interaction between AI empathy perception and AI anthropomorphism has a positive and significant effect on warmth perception ($\beta = 0.216$, $p < 0.001$). This provides preliminary evidence that AI anthropomorphism positively moderates the relationship between AI empathy perception and warmth, as proposed in Hypothesis 2. To further test the research hypotheses, the study used Model 1 from Process v4.1 for additional analysis. The analysis results in **Table 4** show: ① The direct effect of AI empathy perception on warmth perception is 0.551, with a 95% confidence interval of [0.452, 0.649], which does not include 0, indicating that AI empathy perception has a significant positive effect on warmth; ② The interaction effect between AI empathy perception and AI anthropomorphism on warmth is 0.216, with a 95% confidence interval of [0.148, 0.285], which does not include 0, meaning AI anthropomorphism positively moderates the relationship between AI empathy perception and warmth. In other words, an increase in AI anthropomorphism enhances the effect of AI empathy perception on warmth. The moderation effect is shown in **Figure 2**. Therefore, Hypothesis 2 was further validated. In conclusion, both Hypotheses 1 and 2 were fully supported.

Table 4: Process Regression Analysis

Variables	**COEFF**	**S. E**	**T**	**LLCI**	**ULCI**
Constant	3.828***	0.167	22.867	3.499	4.158
Gender	0.003	0.058	0.053	-0.110	0.116
Age	-0.027	0.057	-0.469	-0.140	0.086
Education	-0.006	0.043	-0.150	-0.091	0.078
Seniority	-0.002	0.045	-0.044	-0.091	0.087
AI Empathy Perception	0.551***	0.050	10.991	0.452	0.649
AI Anthropomorphism	0.203***	0.043	4.715	0.118	0.288
AI Empathy Perception*AI Anthropomorphism	0.216***	0.035	6.253	0.148	0.285

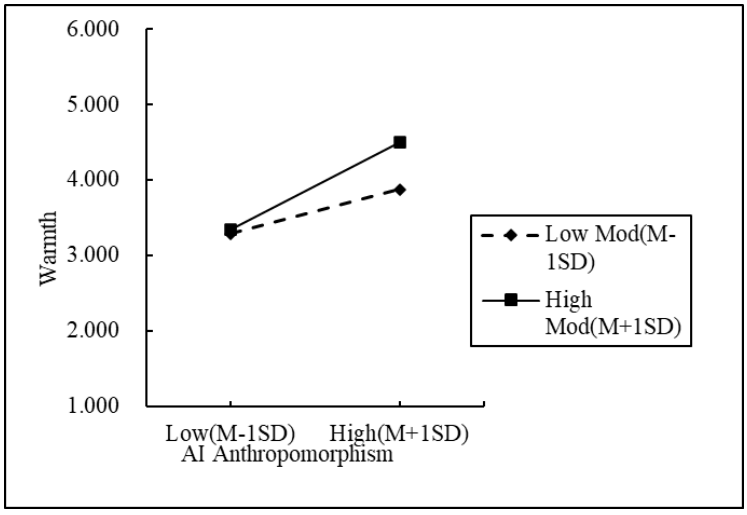

Figure 2: Moderation Effect of AI Anthropomorphism

6. Discussion

The era has witnessed the development of AI, and discussions in the literature on human-computer interaction have become increasingly intense. The introduction of AI into the workplace is a gradual process, and the integration of humans and machines has only just begun. Academic research on this topic remains somewhat one-sided. In order to fully understand the relationship between human employees, AI empathy, and its anthropomorphic characteristics, researchers across various fields need to continue making efforts both theoretically and practically. Below are the theoretical implications, practical implications, and limitations and future directions of our study.

Theoretical implications

Firstly, through empathy, AI is able to express care, recognition, support, and understanding to employees, which in turn stimulates positive emotional perceptions in them. Warmth is a core manifestation of AI empathy, capable of simulating the positive transmission and perception of human emotions. Employees perceive the care and understanding expressed through AI empathy, and this warmth enhances their positive emotional response, thereby improving interpersonal relationships in the workplace. Therefore, AI empathy perception can, to some extent, improve human well-being. This study reminds us of AI's potential in simulating human emotions and deepens our understanding of AI emotional intelligence and human-AI emotional interactions. It contributes to expanding the theoretical framework of the relationship between emotions and artificial intelligence in behavioral science.

Secondly, this study demonstrates the moderating role of AI personification in influencing the perception of warmth through AI empathy. The moderate personification characteristics of AI can reverse the previous bias where human employees perceive AI technology as cold and unfeeling. Personification triggers a social presence related to AI (Andreas, 2023)[60], providing human employees with more empathetic and creative experiential perceptions, which in turn enhances their perception of warmth in AI empathy. From this perspective, it offers a new extension and expansion to social cognition theory, promoting the theoretical development of fields such as human-computer interaction, AI ethics, and organizational behavior (Jennings & Cox, 2023)[61].

Practical implications

First, managers should pay attention to the warmth generated by AI empathy. The warmth created through AI empathy perception can alleviate the feelings of threat, discomfort, and stress that human employees may experience due to the increase in AI team members. Especially now, many people are concerned about AI replacing human jobs and hold a negative, resistant attitude toward the introduction of AI into the workplace (Armin et al., 2019)[62]. Therefore, during human-computer interaction, AI empathy can further help human employees feel warmth in terms of care, belonging, and cognition, thereby mitigating some of these negative impacts. Additionally, human employees should become aware of the importance of warmth and emotional intelligence through AI empathy, which can help them develop their emotional abilities, such as fostering stronger empathy with customers or colleagues, and establishing emotional connections through the transmission of warmth.

Secondly, in the design process of applying empathetic AI within an organization, developers should design certain anthropomorphic features for AI members based on organizational needs, while avoiding the uncanny valley effect. The anthropomorphic traits of AI members, such as their voice, tone, appearance, and behavior, can enhance people's emotional and cognitive perception, as well as their behavioral intentions towards AI. Due to the outstanding work capabilities of AI and the increasingly deep human-AI interaction, the relationship has gradually evolved from human-computer integration to human-computer co-prosperity (Zhang & Wang, 2024)[63]. The design and application of AI anthropomorphism in work interfaces should become more proficient.

Limitations and future research prospects

Firstly, this study did not control for the intensity of AI empathy, which may have a certain impact on human employees' behavior. Future research could explore whether human employees exhibit different perceptions of warmth based on changes in the intensity of AI empathy, leading to different emotional experiences.

Secondly, due to the limitations of the research sample, no differentiated comparisons were made between study participants. Future research and practical applications should consider individual differences and cultural

factors that may influence AI empathy perception and warmth, to ensure that AIs emotional expressions align with individual needs and societal expectations. At the same time, with the integration of digital technologies, AI empathy expression may involve various privacy data of users, which could raise ethical and moral concerns (Xie & Wang, 2024)[64]. This is an aspect that deserves more attention.

Lastly, this study only explored the impact of AI empathy perception on employees' warmth perception in one dimension. As interactions with AI increase, the impact of AI empathy perception in the business field will involve more dimensions. For example, in management tasks, how the deployment of algorithms affects employees' prosocial motivation is an important aspect of workplace productivity and social interaction (Granulo et al., 2024)[65]. Future research could explore other dimensions of impact brought by AI empathy perception on organizations, managers, or employees, such as its effect on leadership forgiveness behavior, employee creativity or performance, enhancement of team collective knowledge, team innovation, improvement of team processes, and the impact on human employees' capabilities and coordination (e.g., the extent to which AI members enhance human workers' abilities, and the adaptability between AI and human work).

7. Conclusion

The results suggest that AI members' empathy perception positively promotes warmth perception, and warmth is related to interpersonal relationships. In other words, the introduction of positive emotions like AI empathy into the workplace brings about positive effects, enhancing the interpersonal relationships between human employees and AI workers. Future research could explore the impact of this warmth perception on employee work effectiveness. Furthermore, the results confirm that warmth, as a dimension of social personal perception, is an intrinsic factor in the impact of AI empathy perception on the workplace. Additionally, AI anthropomorphism can indirectly affect human employees' warmth perception through a moderating effect. The findings emphasize the importance of designing empathetic AI and moderately anthropomorphized AI, as well as the need to study the impact of AI empathy or AI empathy perception on other work processes. Future research should continue to explore human-centered and technology- or tool-centered development directions. The integration of both perspectives, in theory and practice, can significantly enhance organizational effectiveness.

Disclosure statement

The authors report there are no competing interests to declare.

Ethics Statement

Prior to the start of our research, we submitted our research plan to the Academic Ethics Committee of the School of Business Administration of Henan Polytechnic University and obtained the moral approval and review of the plan content. All the participants voluntarily participated in the questionnaire survey, and the participants and institutions written informed provided consent. It is our responsibility to ensure that the guidelines outlined in the Declaration of Helsinki are followed.

Availability of data and materials

Both data and materials can be obtained from the correspondence author. Email address is wyg9999992023@163.com.

Consent for publication

All participants agreed to publish this article. The manuscript has not been published or submitted for publication elsewhere.

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