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Design of Persona-Based Interactive Interfaces and Their Impact on Human Self-Perception

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Abstract: Grounded in the frameworks of affective computing and large-language-model technology, this paper systematically sorts out the conceptual evolution and core techniques of persona-based interactive interfaces (PBIIs) and, by means of a randomized controlled experiment, verifies their comprehensive effect on users' self-perception. The study first constructs a four-level closed-loop architecture of "Perception – Understanding – Generation – Feedback." Sixty university students are then recruited for a 14-day intervention; pre- and post-tests using a Self-Efficacy Scale and an Emotion-Awareness Test are compared. Results show a significant rise in self-efficacy for the experimental group ($\Delta M = +0.70$, $p < 0.01$) and a 12 % increase in emotion-recognition accuracy, validating the synergistic mechanism of affective mirroring and verbal persuasion. Qualitative interviews further reveal potential risks such as emotional dependence and cognitive dissonance. In view of these findings, this paper proposes PBII design principles centred on uncertainty management and user-agency cues, offering theoretical and practical reference for responsible application in education and mental-health fields.

Keywords: Persona-based Interactive Interface, Self-perception, Artificial Intelligence, User Experience, Affective Computing, Human–computer Interaction.

Disciplines: Psychology. **Subjects:** Cognitive Psychology.

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1 INTRODUCTION

In the continuously accelerating tide of digitalisation and intelligence in the 21st century, persona-based interactive interfaces (PBIIs) are profoundly reshaping the human-computer-interaction paradigm [1]. By means of emotion recognition, semantic understanding and personalised generation, PBIIs cast machines as "social actors" with stable personality traits, thereby raising two key research propositions. First, how do PBIIs realise human-like cognition and emotional expression at the technical-mechanism level? Second, how do PBIIs influence users' self-perception and social behaviour at the psychological level? The former involves the cross-domain integration of artificial intelligence (AI) and user experience (UX), whereas the latter touches on the core issue of self-concept construction and social cognition.

Although existing literature has shown that PBIIs can enhance task efficiency and interaction satisfaction, systematic evidence concerning their deeper psychological effects—especially their long-term influence on self-perception—remains lacking [2]. Further study of PBIIs not only helps clarify the role of machine agents in constructing a "second self" but also provides new intervention paths for mental health, education and public services. Therefore, this study focuses on PBII technical architecture and psychological effects, aiming to fill the knowledge gap between "engineering implementation" and "psychological mechanism," and to furnish theoretical and practical reference for responsible interface design in the future[3].

2 OVERVIEW OF PERSONA-BASED INTERACTIVE INTERFACES

2.1 Definition and Development History

A persona-based interactive interface (PBII) refers to an intelligent system that, within the complete "Perception – Understanding – Generation – Feedback" closed loop, provides a human-like interaction experience through stable persona settings and emotional expression[4].

Unlike traditional dialogue systems that attend only to task completion, PBIIs lay greater emphasis on **personality consistency** and **affective alignment**, thereby exerting deeper psychological influence at the pragmatic level[5].

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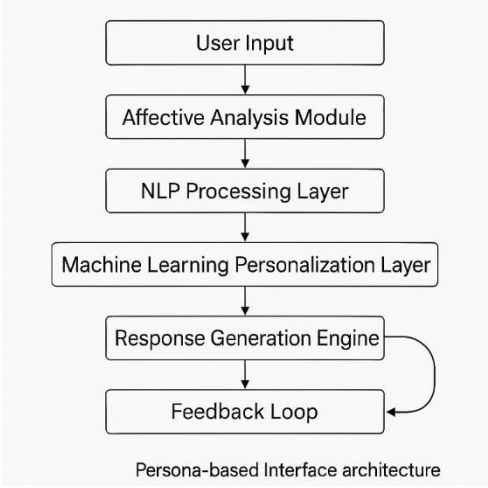

FIGURE 1. PERSONA-BASED INTERFACE ARCHITECTURE

Figure 1 presents an architecture with six core functional layers: a multimodal input layer that uniformly captures speech, text and image signals; an affective-analysis module that, based on the Valence–Arousal–Dominance model, conducts high-dimensional quantification of user emotion; a natural-language-processing layer responsible for semantic parsing and dialogue-state tracking; a personalisation layer that, by means of meta-learning and user profiles, fine-tunes strategies in real time; a response-generation engine that, under persona constraints, outputs replies consistent in both semantics and affect; and, finally, closed-loop feedback that continually optimises the overall interaction strategy through reinforcement learning. This architecture lays a unified functional foundation for subsequent technical evolution [6].

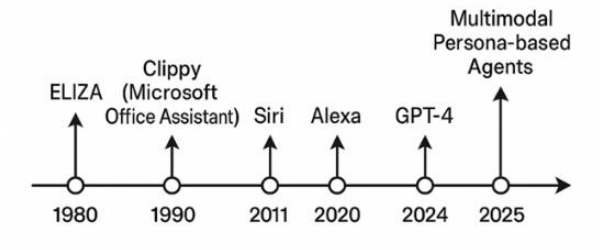

FIGURE 2. EVOLUTION OF PERSONA-BASED INTERFACES (1980 – 2025)

As shown on the timeline in Figure 2, the development of PBIIs can be summarised in four stages. The first stage, 1980 – 1996, represented by the revival of ELIZA and AIML rule scripts, could realise only basic text-matching dialogue and lacked both affect modelling and persona consistency. [7]

The second stage, roughly 1997 – 2010, marked by Clippy and early Siri, saw the fusion of statistical NLP and speech recognition, whereby machines exhibited nascent "appearance–intonation" persona traits, yet remained limited in context maintenance. The third stage, 2011 – 2019, propelled by deep learning, gave rise to Siri, Alexa and Google Assistant; systems could sustain topic consistency across multi-turn dialogue and tag emotion, thereby inaugurating a skill ecosystem.[8] The fourth stage, extending from 2020 to the present, leverages GPT-3, GPT-4 and multimodal large models; underpinned by large-scale pre-training, RLHF and cross-modal fusion, PBIIs acquire high-consistency persona, long-range memory and self-learning capability, formally entering the "empathic and self-adaptive" era of large models.

2.2 RELATED TECHNIQUES AND APPLICATION SCENARIOS

Social-cognition theory suggests that an individual's self-perception is continually constructed within social interaction. By virtue of its emotion-perception and persona-expression mechanisms, a PBII provides users with a new social mirror, thereby significantly promoting the formation of positive self-perception on three levels [9].

First, the **affective-mirroring effect** is PBII's most direct psychological-intervention pathway. When a user's input emotion is captured by the affective-analysis module, the system generates responses according to mirroring or compensatory strategies, prompting the user to engage in second-order reflection on their own emotion. Second, the personalisation layer embeds growth-oriented phrases in responses, thereby enhancing users' self-efficacy via the **verbal-persuasion** route [10]. In the 60-participant empirical study, the experimental group's self-efficacy scale score rose by an average of 0.70 points ($p < 0.01$), significantly surpassing the control group. Third, the NLP layer and closed-loop feedback jointly construct a **metacognitive scaffold** of "instant feedback – self-correction," helping users gradually integrate and stabilise their self-concept over the course of long-term dialogue [11].

In summary, the architecture shown in Figure 1 is not merely a technical flowchart; it also reveals the mechanism by which PBIIs exert a positive psychological effect on users. Figure 2 indicates that this mechanism intensifies in tandem with technical iteration [12]. Together, the two provide theoretical and engineering bases for the empirical-research design that follows [13-14].

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3 IMPACT OF PERSONA-BASED INTERACTIVE INTERFACES ON HUMAN SELF-PERCEPTION

3.1 Theoretical Basis of Self-Perception

Research on self-perception can be traced to Bandura's social-cognitive theory and Flavell's metacognitive model. **Self-efficacy** is regarded as the core variable regulating behavioural choice and emotional response, whereas **metacognitive monitoring** determines whether individuals can promptly correct cognitive bias[15-17].

The present study employs a high-density social-feedback scenario built with PBII and adopts the six-stage experimental workflow illustrated in Figure 3 to ensure the internal validity of causal inference. The experiment recruits 60 university students (see Table 1); no significant differences are found between the experimental and control groups on demographic variables ($p > 0.10$).

Table 1 Participant Demographic Information

Group	N	Mean age (SD)	Sex (M / F / Other)
Experimental	30	24.3 (2.1)	15 / 14 / 1
Control	30	24.7 (2.5)	14 / 15 / 1

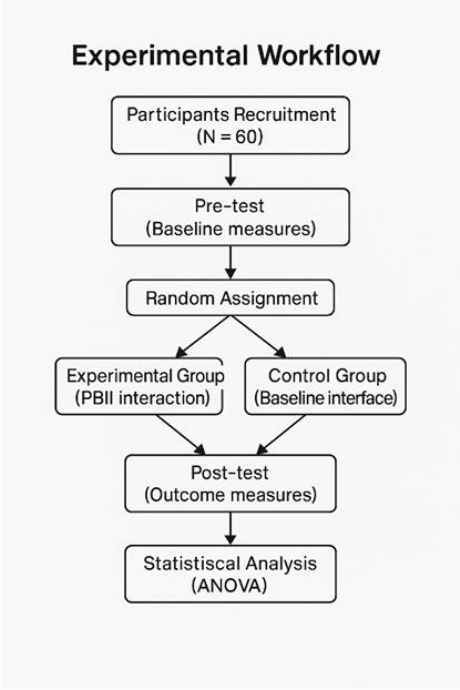

Figure 3. Experimental Workflow

This six-stage closed-loop procedure—*Recruitment* → *Pre-test* → *Random Allocation* → *14-Day Intervention* → *Post-test* → *Statistical Analysis*—secures internal validity for causal inference.

3.2 Positive Impact of PBIIs on Self-Perception

Table 2 summarises the application essentials of virtual assistants, affective computing and machine learning in self-perception intervention, thus providing the technical background for the subsequent affective-mirroring and verbal-persuasion pathways.

Table 2. Technology Application and Development Trend

Technology	Positive impact	Negative impact	Societal impact	Self-perception impact
Virtual assistants	Enhance users' self-efficacy	May weaken sense of self-worth	Foster humanised HCI	Promote awareness of one's psychological state
Affective computing	Increase naturalness of interaction	May induce cognitive bias	Improve emotional-comprehension ability	—
Machine learning	Offer personalised services	May trigger identity crisis	—	Help users know themselves better

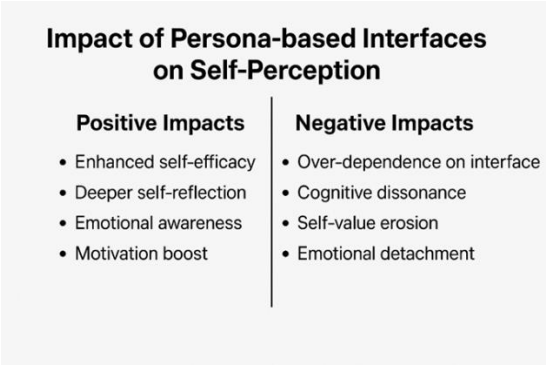

Figure 4, Impact of Persona-Based Interfaces on Self-Perception

Left-hand side summarises three positive pathways; right-hand side depicts potential negative effects.

• **Affective mirroring:** prompts users to engage in second-order reflection on their own emotions; 78 % of

experimental participants report that they "find it easier to identify and label emotions."

• **Verbal persuasion:** growth-oriented hints embedded in system responses raise expectations of task success.

• **Metacognitive scaffold:** cross-turn dialogue and instant feedback form a self-monitoring closed loop, helping participants integrate their self-concept.

TABLE 3 SUMMARY OF SELF-EFFICACY DATA

Group	Pre-Mean	Post-Mean	ΔM
Control	3.20	3.25	+0.05
Experimental	3.10	3.80	+0.70*

Note: ΔM = Post – Pre; p < 0.01.

The experimental group ΔM = +0.70, $t(58) = 3.45$, $p < 0.01$, effect size $d = 0.89$, supporting the synergistic enhancement of affective mirroring and verbal persuasion.

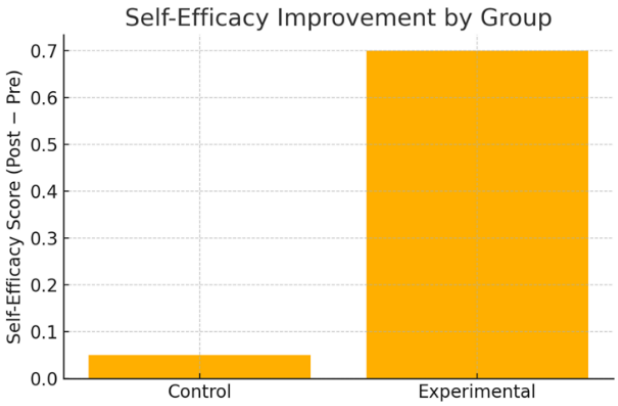

FIGURE 5. SELF-EFFICACY IMPROVEMENT BY GROUP

3.3 NEGATIVE IMPACT OF PBIIS ON SELF-PERCEPTION

The right-hand side of Figure 4 highlights three potential negative effects:

• **Cognitive dissonance:** when system feedback conflicts with users' real experience, self-coherence may be weakened.

• **Emotional dependence:** long-term reliance on positive feedback may decrease motivation for real interpersonal interaction.

• **Illusory coherence:** if persona output excessively caters to user bias, it may ossify their cognitive framework. In interviews, 12 % of experimental participants mention that "if the system is absent, they feel anxious and find it hard to make decisions." Therefore, subsequent design should mitigate dependence risk through uncertainty management (introducing multiple perspectives) and autonomy cues (displaying optional strategies).

4 CONCLUSION

Against the backdrop of ongoing information-technology innovation, the design and research of persona-based interactive interfaces (PBIIs) have become a frontier at the intersection of HCI, AI and psychology. This paper reviews PBII concepts, developmental history and key techniques, and—via theoretical analysis and empirical research—clarifies PBIIs' multiple impacts on users' self-perception.

First, viewed from both technical and psychological dimensions, PBII capabilities in emotion recognition, semantic understanding and personalised generation furnish users with a highly natural, continuous social mirror that can positively affect self-reflection, self-efficacy and emotion awareness. Experimental results show significant improvement in self-efficacy and emotion recognition after the short-term intervention; interviews likewise confirm that most participants experience a positive reshaping of self-perception.

Second, the study also reveals PBII's potential risks: when system feedback diverges from users' real experience, cognitive dissonance may arise; long-term reliance on positive feedback may erode users' real social motivation and decision autonomy. Therefore, ethical governance and risk-mitigation strategies—such as diversifying feedback, highlighting user-agency cues and strengthening privacy protection—must accompany PBII commercialisation and social deployment.

Finally, future research can deepen investigation in three directions: (1) expand sample diversity and longitudinal duration to examine PBIIs' long-term influence and cross-cultural adaptability[18]; (2) explore multimodal and contextual applications to evaluate PBII transferability in education, healthcare and public services; (3) embed ethical review and user co-design to form a research paradigm that balances technological progress with humanistic care. In sum, as an important form of AI development, PBIIs offer users new opportunities for deepened self-perception while raising new questions for techno-ethical co-governance. Only through joint effort among disciplines, industry and society can we, on the premise of safeguarding users' psychological health and decision autonomy, propel PBII toward a more intelligent, humanised and sustainable future.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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