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Connecting With the Future Ecological Self Through LLM Agents

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ABSTRACT

This study explores the potential of large language model (LLM) agents to bridge the psychological distance between individuals and their future ecological selves. We employed a pre- and post-test experimental design, supplemented by a pilot study (N = 6) incorporating semi-structured interviews and topical analysis. Key findings from the pilot study revealed several key themes: textualized sensory memory, algorithmic alienation, place attachment, and moral reactance. Furthermore, future research on pro-environmental behavior intention should shift from self-reported intentions to long-term behavior assessments. This study provides feasible evidence for different possible self AI prototypes that promote pro-environmental behavior, while highlighting design implications for associating authentic ecological identity with sensory-rich narratives and familiar place connections.

Keywords: Ecological self, Possible selves, LLM agents

INTRODUCTION

The escalating global ecological crisis has made sustainability a shared global concern, yet a significant "knowledge–behavior gap" remains due to the psychological distance between individuals and the future environment. The concept of the Ecological Self, proposed by Arne Naess, suggests that individuals can expand their self-identity to encompass the natural environment, perceiving environmental protection as an act of caring for an enlarged sense of self (Naess, 1989). Recently, Large Language Models (LLMs) have made it possible for AI to play the role of "another self." (Pat et al., 2024) However, current research on AI self-persona has rarely extended to specific ecological domains or incorporated deeper self-theories, leaving the potential of LLM-driven ecological identity unexplored.

This research aims to bridge this gap by integrating LLM agents with self-theory, extending their application to the ecological domain to explore the connection between sustainability and the individual. Current HCI research has begun to leverage LLMs for self-exploration, with most studies focusing on self-AI dialogues with elderly self-images, creating ideal self-personas for therapeutic conversation, or facilitating communication with the future self via digital letters. These interventions have shown promise in areas such as mental health support and long-term goal management by utilizing the role-playing capabilities of LLMs (Meyer et al., 2025).

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However, while these studies provide a foundation for future-self AI dialogues, their agent designs remain largely limited to a single, static future self, often ignoring the psychological complexity of identity motives. According to the Possible Selves Theory, the future self is multifaceted, and deeply influenced by distinct identity motives (e.g., hoped-for vs. feared selves) (Markus & Nurius, 1986). Therefore, this study will explore how integrating rich self-theory and motivation theory can impact the efficacy of AI-driven dialogues. Furthermore, this study aspires to deliver public value and practical significance by addressing sustainability issues through a future-oriented, personalized AI intervention.

In this ongoing research, the effects of future self type (hoped-for, feared, and realistic) and regulatory focus (promotion vs. prevention) on an individual's future self-continuity, ecological self-identity, and pro-environmental behavioral intentions (PEBI) will be examined. By bridging complex psychological processes with real-time LLM-mediated dialogues, this study aims to foster a stronger connection between individuals and the ecological environment, ultimately providing a scientific basis for designing future-oriented digital interventions for sustainability.

LITERATURE REVIEW

Ecological Self

The ecological self represents the extent to which an individual integrates the natural world into their self-concept, thereby transforming environmental protection from an external moral obligation into an intrinsic motivation (Naess, 1990). Environmental psychologists have conducted operationalized empirical research based on this philosophical concept, confirming that individuals' perceptions of their ecological self are significantly associated with pro-environmental behaviors and psychological well-being (Clayton, 2003). While environmental psychology emphasizes the ecological self as a strong predictor of sustainable behavior, current human-computer interaction (HCI) interventions often focus on future ecological visualization rather than identity internalization (Tao et al., 2025). This results in users who, despite being environmentally aware, lack a deep connection with the environment. This study aims to explore how dialogue mediated by large language models (LLMs) can proactively cultivate the ecological self through personalized identity reflection.

Future Self Continuity

Future Self Continuity (FSC) is defined as the perceived psychological overlap or coherence between one's present and future self (Hershfield et al., 2009). FSC can be technologically(eg. visual aging techniques, LLM-driven narrative interventions) enhanced to promote a wide range of long-term behaviors, including saving, health maintenance, and ethical conduct (Hershfield et al., 2011; Rutchick et al., 2018). Building upon these findings, this study proposes that such effects can be extended to ecological contexts.

Possible Selves

The theory of Possible Selves, first introduced by Markus and Nurius (1986), represents a future-oriented core component of self-concept. It describes how individuals envision who they might become, who they would like to become, and who they fear becoming. Possible selves operate not only as motivational drivers but also as mechanisms of self-regulation. When a gap exists between one's actual and possible self, individuals with sufficient cognitive resources engage in regulatory actions. (Oyserman & Horowitz, 2023). This process aligns closely with Regulatory Focus Theory, which differentiates between promotion-oriented and prevention-oriented motivational tendencies. People with a promotion focus pay attention to how to achieve success and reach ideal states, while People with a prevention focus pay attention to how to avoid failure, fulfill responsibilities, and maintain safety (Higgins, 1997).

Summary of Research Opportunities

In summary, while prior studies have established the importance of identity and temporal connection, there remains a lack of integrated, personalized interventions that combine possible selves with motivational alignment in the ecological domain. By utilizing LLMs-mediated dialogue to enhance FSC and activate the ecological self, this study provides a novel methodology to transition from passive environmental awareness to active, identity-driven stewardship.

SYSTEM DESIGN

This research developed an interactive web-based platform designed to facilitate psychological reflection through LLM-mediated dialogue. The system utilizes a three-stage narrative pipeline to ensure the vividness and personalization of the agent. Initially, participants complete an autobiographical narrative survey (McAdams, 2018) consisting of six open-ended questions covering past ecological experiences, daily interactions with nature, and future expectations. The system then employs a few-shot prompting strategy leveraging LLMs, integrating these personal narratives into pre-defined theoretical templates to construct three distinct future-self personas: Hoped-for, Feared, and Realistic. To ensure the reliability of interventions and to address the ethical implications of LLMs, the platform will implement controls over the accuracy, logical consistency, and safety of AI outputs.

Figure 1: Three-stage pipeline to customize future self.

Autobiographical Survey

According to the narrative-self theory, a person's self-perception stems from how they narrate their own story, especially how they connect the past, present, and future (McAdams, 2018). To construct the user's ecological self, an autobiographical survey questionnaire is designed to generate a

personalized future self AI for each participant. The questionnaire is intended to guide participants in recalling and describing personal experiences and feelings related to the research topic through written narratives. It consists of six open-ended questions focusing on three dimensions: past experiences with nature, daily interactions with nature, and the self in relation to the future. All questions are open-ended, allowing participants to respond freely in their own words.

Persona Feature Extraction

Participants' open-ended responses will be entered into a pre-designed AI prompt template. The template is designed to generate possible selves related to each ecological future self, based on their autobiographical experiences.

Table 1: Structure and logic of the LLM system instructions.

Setting	Content
Role	Defines the agent as the participant's future self 30 years from now, specifically tailored to the assigned experimental condition.
Context	Injects user memories, current lifestyle habits, and environmental expectations from autobiographical survey.
Task	Enforces interaction goals to enhance users' reflections on pro-environmental behavior.

As shown in Table 1, the system instruction is based on individual user inputs, ensuring a highly personalized and immersive intervention experience.

Possible Selves Configuration

Building upon the system instructions outlined in Table 1, the experiment platform configured the agent's persona based on the Possible Selves Theory. Three distinct configurations were developed to match the experimental conditions:

1. Hoped-for Future Self: This configuration presents an idealized future where the participant has successfully achieved harmony with nature.
2. Realistic Future Self: This role serves as a descriptive mirror, reflecting the projected impact of current habits without significant behavioral changes.
3. Feared Future Self: This configuration depicts a dystopian but plausible future characterized by environmental degradation and personal regret.

PILOT USER STUDY

Research Questions

Based on the initial implementation of the system design, this study focuses on exploring the following two questions through a pilot study, aiming to provide a design basis for subsequent large-scale intervention experiments:

- RQ1: Can the LLM-based "Future Ecological Self" dialogue system guide users to engage in continuous and in-depth self-reflection dialogue while maintaining narrative logic?

- RQ2: In the process of constructing ecological identity through dialogue, which design factors will affect users' psychological immersion or create obstacles?

Participants and Procedure

A preliminary pilot study (N = 6) is conducted to evaluate the system's feasibility and psychological impact. The participants were all young people aged 20–35 with the same level of education.

This study utilizes validated standardized scales to ensure measurement reliability:

- Ecological Self: Measured via the Environmental Self-Identity (ESI) Scale (Clayton, 2007)
- Future Self-Continuity: Assessed via standardized FSC scales measuring psychological overlap (Hershfield et al., 2009).
- Pro-Environmental Behavior Intention (PEBI): Evaluated through a customized 10-item questionnaire covering daily green consumption and waste management habits.

Participants were assigned to three framing conditions: Hoped-for (P1, P6), Feared (P2, P5), and Realistic (P3, P4). Each session included an autobiographical survey, a pre-test (ESI, FSC), a 10-round memory-grounded AI interaction, a post-test (ESI, FSC, PEBI), and a semi-structured interview.

Data Result

Given the exploratory nature of this pilot study and its limited sample size (N = 6), inferential statistics are not performed here. As shown in Table 2, preliminary descriptive data show that ESI and FSC scores trended upward after interaction, while PEBI scores were higher, especially under the Feared-For condition. This suggests that the system has a potential facilitating effect on the presence of ESI and PEBI.

Table 2: Test result.

Participant	Condition	ESI	FSC	PEBI
P1	Hoped-for Self	+3	+1	6.0
P2	Realistic Self	0	+1	4.0
P3	Feared Self	+5	+2	5.0
P4	Feared Self	0	+4	6.5
P5	Realistic Self	-2	0	5.0
P6	Hoped-for Self	0	0	5.0

Thematic Analysis

By conducting thematic analysis of the interview content, the study discovered several key contradictions, which helped to gain a deeper

understanding of the limitations of the current prototype, which helps the future large-scale study.

- Textualizing Sensory Memories: Participants expressed that their autobiographical memories of nature were often "scattered fragments" and "vivid images" rather than structured text. Forcing these sensory experiences into a text box led to a loss of narrative intensity. As the interviewee noted, "My mind is full of visual scenes, but describing them in words feels weak." This highlights a demand for multimodal elicitation (e.g., image-based inputs) to better capture the essence of personal memories.
- Algorithmic Alienation: A recurring feedback was the "patchwork" or "templated" feeling of the AI's responses. Participants felt that the AI was merely reassembling their input into fixed sentence structures rather than genuinely responding to the specific, grounded details they provided. Therefore, fine-tuning should be incorporated into the AI's prompting technology to make the dialogue more natural.
- Place Attachment: Participants showed a high level of interest in the future evolution of their "hometown" or "university campus." Current AI descriptions of future environments are too abstract, making it difficult for people to relate to them. However, when future scenarios are anchored in places where they have strong emotional connections, this location-based intimacy can likely strengthen the connection with their "future selves."
- Moral Reactance: Participants reported experiencing a sense of moral trial when the AI discussed environmental degradation and emphasized individual responsibility. They believed that environmental responsibility should be attributed more to the state, government, or large organizations, rather than simply to individual lifestyles. Further exploration is needed to refine the AI's role in a feared-self context, and ethical considerations are essential to achieving a balance.

Thematic analysis revealed the findings of RQ1 and RQ2. Participants demonstrated high engagement and offered suggestions on the design elements of this AI dialogue prototype.

DISCUSSION AND FUTURE WORK

This study is a preliminary experiment. Future formal experiments will explore the differences in the impact of different possible selves on future ecological selves and environmental behavior, as well as the moderating role of different motivations. The current study did not consider ethical and safety issues. Fear of self may have adverse effects on participants. This ethical issue must be considered in future studies, such as screening participants for anxiety before the experiment and providing positive guidance after the dialogue to ensure their psychological safety. The current study has insufficient variable measurement, especially in the indicator of pro-environmental behavior intention, which was only post-tested. Future studies should also measure participants' original environmental behaviors to assess the effectiveness of

the intervention. Furthermore, long-term behavior measurement should be considered in future studies. Regarding participant selection, in the context of the ecological environment, only factors such as gender, age, and education level were considered, without considering the influence of the participants' own environmental awareness. The current system design is relatively simple. Future designs should consider the themes mentioned in the interviews, such as incorporating images based on the future vision of their hometown, and using prompt design to make the dialogue more natural.

CONCLUSION

This study investigated the potential of an LLM-driven dialogue system to enhance pro-environmental behavior intention by connecting individuals with their "Future Ecological Selves." Our preliminary findings from the pilot study demonstrate that integrating autobiographical narratives into AI prompts significantly enhances user engagement and fosters a stronger sense of future ecological self. While quantitative trends indicated an increase across experimental conditions, qualitative feedback provided deeper insights into the mechanisms of this connection, highlighting the roles of sensory grounding and place attachment. Despite identified challenges such as algorithmic alienation and moral reactance in specific personas, participants generally perceived the AI-mediated dialogue as a vivid and impactful medium for self-reflection. This suggests that personalized AI agents can effectively transform abstract environmental crises into relatable, personal experiences.

Our study underscores the transformative potential of Generative AI in environmental psychology and behavior intervention. By shifting the focus from generic information dissemination to personalized, identity-based narratives, this research provides a feasible blueprint for future digital interventions aimed at promoting PEBI. Future work should focus on refining the emotional valence of AI personas, addressing the ethical risks of eco-anxiety, and validating long-term behavior changes in large-scale longitudinal studies. As LLM technologies continue to evolve, they hold great promise for creating more immersive and ethically-grounded tools to cultivate an individual ecological consciousness and drive sustainable societal change.

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