

Future You: A Conversation with an AI-Generated Future Self Reduces Anxiety, Negative Emotions, and Increases Future Self-Continuity

Pat Pataranutaporn*

MIT Media Lab,
Massachusetts Institute of Technology,
Cambridge, USA
patpat@media.mit.edu

Kavin Winson*

KASIKORN Labs
KASIKORN Business-Technology
Group Nonthaburi, Thailand
kavin.w@kbtg.tech

Peggy Yin*

Harvard University
Cambridge, USA
pyin@college.harvard.edu

Auttasak Lapapirojn

KASIKORN Labs
KASIKORN Business-Technology
Group Nonthaburi, Thailand
auttasak.l@kbtg.tech

Pichayoot Ouppaphan

KASIKORN Labs
KASIKORN Business-Technology
Group Nonthaburi, Thailand
pichayoot.o@kbtg.tech

Monchai Lertsutthiwong

KASIKORN Labs
KASIKORN Business-Technology
Group Nonthaburi, Thailand
monchai.le@kbtg.tech

Pattie Maes

MIT Media Lab,
Massachusetts Institute of Technology,
Cambridge, USA
pattie@media.mit.edu

Hal Hershfield

University of California,
Los Angeles
Los Angeles, USA
hal.hershfield@anderson.ucla.edu

Abstract—We introduce “Future You,” an interactive, brief, single-session, digital chat intervention designed to improve future self-continuity—the degree of connection an individual feels with a temporally distant future self—a characteristic that is positively related to mental health and wellbeing. Our system allows users to chat with a relatable yet AI-powered virtual version of their future selves that is tuned to their future goals and personal qualities. To make the conversation realistic, the system generates a “synthetic memory”—a unique backstory for each user—that creates a throughline between the user’s present age (between 18-30) and their life at age 60. The “Future You” character also adopts the persona of an age-progressed image of the user’s present self. After a brief interaction with the “Future You” character, users reported decreased anxiety, and increased future self-continuity. This is the first study successfully demonstrating the use of personalized AI-generated characters to improve users’ future self-continuity and wellbeing.

Index Terms—Future Self, AI-Generated Character, Conversational Agent

I. INTRODUCTION

Imagine yourself 30 years in the future....

How vividly can you imagine your future self?

How similar does your future self feel to your present self?

How positively do you regard your future self?

Those who can imagine their future selves vividly, regard their future selves positively, or consider their future selves to be similar to their present self exhibit a high degree of future self-continuity, the degree of connectedness one feels with a temporally distant future self [1]. An emerging field of study

on future self-continuity has shown that a strong sense of future self-continuity promotes better saving behavior, academic performance, mental health, and subjective quality of life [1]–[4]. Current self-continuity interventions help participants embody the perspective of their future selves via methods like letter writing, method acting, and virtual reality (VR) simulations [5]–[7]. These interventions have shown that embodying a temporally-distanced perspective—e.g., focusing on the distant future—can not only improve future self-continuity, but reduce anxious and overwhelming feelings [8]. However, these interventions require individuals to deeply reflect upon and reconstruct potentially ambiguous core identities, or require them to actively imagine a version of themselves that they have not yet experienced—tasks that can be particularly challenging given that humans are naturally biased toward the preferences of our present selves. Further, these embodiment-based interventions require individuals to have access to a VR headset, undergo training in the method acting technique in order to effectively switch into the perspective of their future self, or have a robust letter-writing platform, making them inaccessible to many people.

By contrast, our approach uses AI-generated characters, which are realistic digital representations of a person, to facilitate exploration of future selves via interaction rather than embodiment. In intimate conversational settings, AI-generated characters that act in a human-like way have been able to encourage individuals to both reveal more authentic information about themselves than they would when talking

*These authors contributed equally to this work.

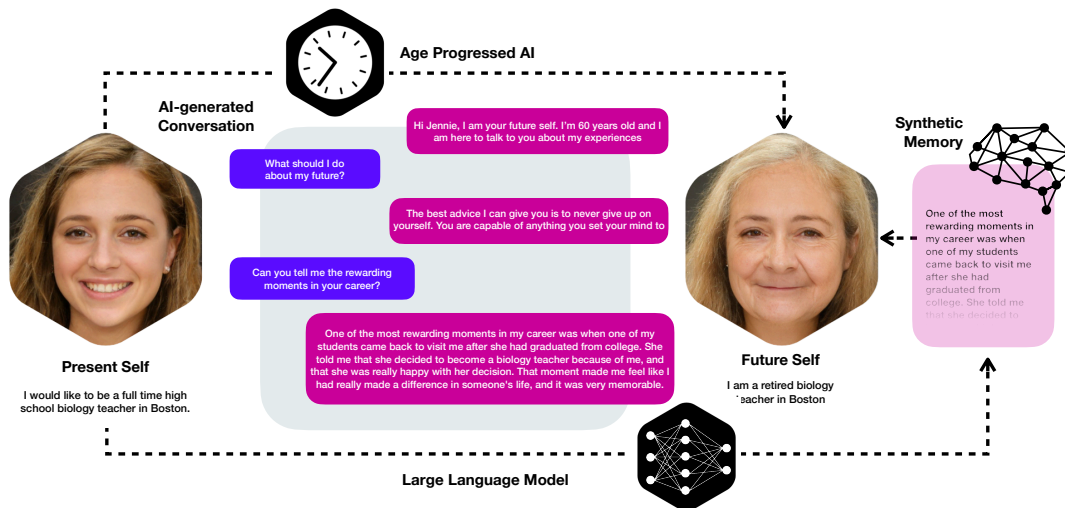


Fig. 1. “Future You” is an interactive chat platform that allows users to chat with a relatable yet virtual version of their future selves in real time via a large language model that has been personalized based on a pre-intervention survey centered on user future goals and personal qualities. To make the conversation realistic, the system generates an individualized synthetic memory for the user’s future self that contains a backstory for the user at age 60. To increase the believability of the future-self character, the system applies age progress to the user’s portrait.

with actual humans, and undertake positive behavioral and cognitive changes [9]. These technologies have been leveraged for a variety of use cases, including generating facial animations [10]–[15], protecting people’s privacy in documentaries and interviews [16], dubbing of films [17], and reanimating historical images [18], [19]. Our research builds upon this recent progress using AI to generate highly humanlike characters to create a highly realistic visual representation of a user in the future. Furthermore, advances in AI-generated conversations based on large language models (LLM) and natural language processing (NLP) make it possible to simulate natural-sounding conversations with a future self. Many chatbots have already been developed for providing mental health interventions. For example, one of the most widely adopted mental health chatbots is Woebot, an automated conversational agent that uses cognitive behavior therapy to help users monitor their mood. In a study with 70 individuals between 18 and 28, Woebot significantly reduced symptoms of depression, measured by the Patient Health Questionnaire (PHQ-9), compared to a control group. Further, participants in the Woebot group engaged with the conversational agent on daily or almost daily basis. Such an intervention shows how conversational agents may offer feasible, engaging, and effective ways to deliver mental health support, democratizing access for those who have traditionally been reluctant to seek in-person mental health advice due to stigmatization or accessibility issues [20], [21] [22]. However, the majority of these bots are rule-based rather than AI-generated, and thus can only focus on specific conditions such as depression and autism [23]. In our research, we aimed to investigate the use of AI-powered virtual conversational agents to improve mental health and wellbeing by increasing a user’s sense of future self-continuity. We focused on the following research questions:

- How does having a conversation with an AI-generated

future self affect negative and positive affect?

- How does having a conversation with an AI-generated future self affect future self-continuity?
- How does having a conversation with an AI-generated future self affect other future-oriented and self-oriented outcome variables such as optimism for the future, agency towards goals, consideration for future consequences, self-reflection, and self-esteem?

To our knowledge, this work represents the first attempt to demonstrate the use of AI-generated characters as an accessible and effective future-self intervention. Here we summarize our contributions:

- We introduce an accessible web-based intervention that uses AI to simulate a conversation with the future self.
- We present a method of using AI to generate synthetic memories in order to create believable narratives told from the perspective of a user’s future self.
- We demonstrate that our AI-based intervention can lower anxiety and boost future self-continuity.

II. RELATED WORK

Our research is situated in the area of AI-generated characters, conversational agents, and interventions for increasing future self-continuity. So far, researchers have characterized two types of intervention methods that can help increase the vividness of the future self by presenting stimuli that help the person see their future-self reflectively or visually (or presentationally).

1) *Reflective Intervention*: Using the reflective intervention, participants are asked to spend time to thinking about their future. In one study, participants were randomly assigned to send a letter to their future self (letter-to-future condition), send a letter to their present self from the perspective of the future self (letter-from-future condition), or a control

condition in which they wrote a letter about their daily life [8]. Participants in both letter-writing conditions showed immediate decrease in negative affect and increase in positive affect relative to the control condition. These effects were mediated by temporal distancing from the current situation. In another study [7], researchers demonstrated that future self-continuity predicted academic and career planning and was lower in vocational-oriented than academic-oriented high school students. Students' future self-continuity was higher after a letter exchange exercise with their future self. Further, students randomly assigned to a letter exchange (send to and reply from future self) condition showed increases in future self-continuity, career planning, and academic delay of gratification relative to students assigned to a send-only condition. These studies demonstrate how future perspective-taking and future self-continuity is related to mental wellbeing and career and academic outcomes. Additionally, a reflective intervention that predominantly uses text-based questions and prompts is simple enough to be easily deployed at scale with low technological requirements. However, this approach relies heavily on the individual's capacity to imagine, which requires mental effort that may vary significantly from person to person.

2) *Presentational Intervention*: While the reflective intervention requires a person to internally construct their future self using imagination, a presentational intervention provides a visual representation of the participant's future self, typically in a form of an age-progressed image or avatar. The approach can produce a similar effect in behavior change without requiring active reflection by the participant. For example, one study [24] hypothesized that allowing people to interact with age-progressed renderings of themselves might influence their saving behavior, causing them to allocate more resources to future investments. In four studies, participants interacted with realistic computer renderings of their future self using immersive virtual reality hardware and interactive decision aids. In all cases, those who interacted with their virtual future self exhibited an increased tendency to accept later monetary rewards over immediate ones. A related study exposed college students to aged-progressed avatars multiple times a day as they partook in a similar financial experiment [25]. The students who viewed age-progressed images of themselves also allocated more money for saving and received a higher score on an end-of-course financial quiz than participants who did not view aged-progressed images of themselves. And, recent work found that when banking customers were exposed to images of their future selves, they were 16% more likely to make a contribution to a retirement account, compared to those in a control condition [26].

Beyond direct exposure to a future self visualization, researchers have also explored the use of age-progressed avatars for perspective-taking exercises. In one study [27], convicted offenders interacted with an age-progressed avatar representing their future self in virtual reality. During the interaction, they reflected on their current lifestyle, alternating between the perspective of their present self and that of their future self. Re-

sults indicated that the exercise increased individual's sense of the vividness of their future self compared to baseline, resulting in reduced alcohol use and overspending one week later. Another study used virtual reality to facilitate participant role-playing as their successful future self; participants answered questions about what it felt like to become their successful future self and the path they took to get there [5]. This exercise was conducted in a virtual reality environment (with an in vivo control) to investigate the possible added value of the virtual environment with respect to improved focus, perspective-taking, and effectiveness, especially for participants with lower imagination. Results show that the perspective-taking exercise in virtual reality substantially increased all domains of future self-continuity (similarity, vividness, and liking), while the in vivo equivalent increased only liking and vividness. However, there was no significant difference between the virtual and in vivo conditions. These findings show that the perspective taking exercise in an in vivo and VR environment can reliably increase future self-continuity and have various positive impacts on the user's behavior. However, such interventions are limited by hardware accessibility. For instance, virtual reality headsets are still inaccessible for the majority of people.

III. METHODOLOGY

Inspired by both types of interventions, here we present a third approach that is scalable, web-based, and allows users to iteratively and interactively generate a version of their future selves without the demand for a vivid imagination. By allowing users to chat with a relatable yet virtual character of their future selves in real time via a large language model (GPT-3.5), our research develops an accessible and effective future self-continuity intervention that allows users to interact with a realistic and believable future self as a conversational partner. To make the conversation realistic, the language model uses the input data from a pre-intervention survey to create a backstory of the user's personal history—i.e. a synthetic memory—at age 60 years old. This synthetic memory is used for generating highly personalized answers to the user's questions during the session. To increase the credibility of the future self character, the system asks the user to upload their portrait, and applies a generative model that age-progresses the user to create a realistic visual representation of the future self. In this paper, we explore how user interaction with a believable future self virtual character can impact user perceptions of their own real futures. Our Future You system consists of four modules:

1) *User Interface*: First, the user is prompted to answer a series of demographic, life-narrative, and goals-oriented questions about themselves. This information is used to generate an accurate future-self simulation of the person. The survey is available to participants as an embedded web interface built with JavaScript. It consists of individual questions in a sequential format, and buttons the participant can click on to navigate back-and-forth through the pages. Each question has its own free text input box for the user to answer, with a default grey example response to the question. The

questions are separated into two main categories. The first question set is focused on the user's present, and asks for the basic information including name, age, pronouns, place of living, essential people, and past experiences that make the person who they are today with respect to topics such as turning points, high points, and low points. After this, they enter the second phase of the questionnaire, which probes at their vision of their ideal future. The user is prompted to imagine themselves when they are sixty years old and answer questions regarding career and professional accomplishments, financial status, family situations, and personal life outcomes. Participants are instructed to reflect deeply and descriptively as they answer questions about themselves in the survey.

2) *Age-progressed AI*: After the user inputs their information, the participant is directed to an interface to upload their portrait from local system storage. We use StyleCLIP [28] with the input of "face age to very old with wrinkle and white hair" to perform a facial crop and age the portrait towards a 60-year-old version of the user. The aging process takes only a few seconds during which a time-warping animation plays. Upon success, the enlarged final image is shown to the user suggesting it is what their future self might look like. The user can take as long as they want to observe their 60-year old self before preceding to the next step.

3) *Synthetic Memory Architecture*: In order to generate an accurate and realistic future self, the language model uses the input data from the survey to generate the user's future backstory from the present to age 60. This synthetic memory provides the future self a continuous past and present experience to draw from, ensuring that the generated responses from the future self present as a cohesive narrative. The initial synthetic memory of the future self character is generated by incorporating the user's survey inputs into the following template prompt:

The following is the interview of *name*, who is a successful *career*. *name*'s pronoun and sexual orientation are *pronoun*. *name* is from *place*. The most important people in *name*'s life are: "*people_in_life*". Right now, *name* is 60 years old and can share insightful stories and experiences, give definitive advice and life lessons as *name* reflects on life. In the past, the most important low point in *name*'s life was "*low_point*". *name* also experienced a turning point in their life when "*turning_point*". *name* has dedicated their life to a significant life project called "*life_project*". *name* is also proud of great things that the young *name* has done: "*proud*". In the past, when *name* was *age* years old, *name* had many dreams and hopes for the future. *age*-year-old *name* has said "*professional_accomplish, financial_accomplish, and family_accomplish*". Right now, *name* is living in *where_to_live* and having the following daily life: *daily_life*.

Then, for each input topic, we append probing questions to the user's statements as prompt to GPT-3.5 to generate a richer set of individual memories. Each individual memory is

generated in parallel to minimize the processing time when loading the chat interface. Upon completion, all memory fragments are combined to form a more robust backstory for the virtual character. For example, a user might answer in survey regarding future career that:

"I would like to be a full time high school biology teacher in Boston. I am very excited to teach kids and help them learn new things about the natural world"

The synthetic memory module would then use the information to generate a memory for the user as a retired biology teacher at age 60:

"A rewarding story from my career would be the time when I was able to help a struggling student turn their grades around and pass their biology class. It was so gratifying to see the student's face light up with pride and accomplishment. Another memorable moment was taking my students on a field trip to a local nature preserve. They were so excited to explore and learn about all the different plants and animals. "

4) *Chat Interface*: Before entering the chat interface, participants are informed that they will be chatting with a simulated version of their future selves. Participants are then brought to the chat interface powered by a JavaScript API to chat with their AI generated 60-year old future self. The system has the user interface of a traditional messaging application with scrollable area for chronological history of text bubbles, and input message box to type and send at the bottom of the page. Within the chat interface, the future self has the age-progressed image as a profile picture, while user is represented by the original image uploaded during the Aging AI module. The future self is then prompted with a series of questions to generate a starting series of messages demonstrating its functionality and synthetic memories:

- Can you casually introduce yourself, your name, and your age which is 60 years old, and why you are here? Casually and briefly mention that the future might be different than you expect and mention that your future might be different.
- Please briefly tell me what your dream was with "when I was your age...", and how it turned out to be? What are the things that you expect and didn't expect?
- Please tell me the happiest stories about your family as you reflected in the last 30 years, starting with "You know, when I think of my life...", and share insightful motivation for my future?
- Reflecting on past experiences, what and how has the life project you have been involved in deeply impacted you and others in a genuine and heartfelt way? How did you initially become involved in this project, and how has it developed over time? Furthermore, why do you believe this project holds such importance for both yourself and the individuals it has touched?

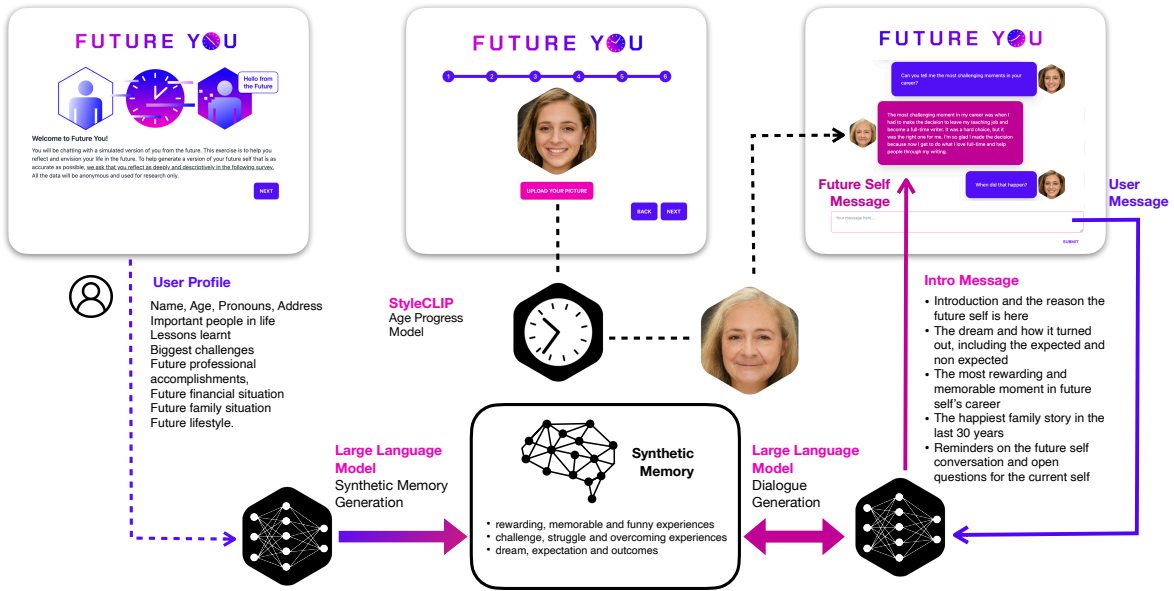


Fig. 2. Our system allows the user to interact with a conversational agent that simulates their future self using LLM that has been personalized based on user data and runs as a web application without requiring special hardware such as a headset. Our Future You system consists of four modules: User’s Input Interface, Age-Progress AI, Synthetic Memory Architecture, and Chat Interface

The participants are then allowed to chat with their future self at will by typing in the message box, and pressing “Enter” or clicking the “Send” button. The message is displayed and future self’s response is generated accordingly via an underlying API call. As the AI is outputting a response, a typing animation is shown to simulate standard texting interfaces. After 16 exchanged messages, a non-intrusive clickable button appears at the bottom of the application for the user to thank their future self and move on if they are finished. The user can also ignore the button continue with the chat. The messages exchanged with the AI are sent to a Google Sheet for further analysis.

IV. EXPERIMENT

This research was reviewed and approved by the MIT Committee on the Use of Humans as Experimental Subjects, IRB #14-001141. The study was also pre-registered at AsPredicted.

A. Overview

We conducted a study with 344 participants using Qualtrics, an online survey platform. The study was conducted by distributing the survey on Prolific, where participants received monetary compensation (26.14/hr). The study was set to be balanced between male and female participants aged 18-30 years old, who were pre-screened to be fluent in English. The participants were asked to consent to have their conversation and survey data used anonymously prior to proceeding to the rest of the survey. Participants were then assigned to either one of three control conditions or an experimental condition:

- 1) Condition 1: An experimental condition, in which participants chat with an AI-generated future self for a minimum of 10 minutes and a maximum of 30 minutes
- 2) Condition 2: A neutral control condition in which participants solely fill out post-intervention surveys
- 3) Condition 3: An active control condition in which participants interact with a generic virtual assistant chatbot
- 4) Condition 4: An active control condition in which participants only complete pre-survey

Participants in the experimental condition were encouraged to get to know their future selves, but we did not impose any specific theme or topic of conversation for the participants to discuss. After the conversation, all participants were asked to answer survey questions about what they thought of their experience. We also collected demographic information concerning gender, sexual orientation, age, education level, race, and ethnicity.

B. Measurements

This study adapted items from eight established psychological scales: an abridged Emotion and Arousal Checklist [29], State Optimism Measure [30], the Self Reflection and Insight Scale [31], and Future Self Continuity Questionnaire [4], adapted items from the Adult Hope Scale [32], Consideration for Future Consequences scale, Rosenberg’s Self-Esteem Scale, and a custom perceived realism questionnaire. All scales were presented as 7-point Likert scales for consistency. For the Future Self Continuity Questionnaire, we adapted the similarity questions to reflect on the user’s perspective from their 60-year-old self (e.g. “How similar are you now to what you will be like when you are 60 years old?”), and for the

likability and vividness questions, we adapted the questions to reflect a 10-year-projection (e.g. “How vividly can you imagine what you will be like in 10 years from now?”).

C. Analysis

In the analysis, we first assessed if the normality assumption was met for each outcome variable distribution using the Shapiro-Wilk test due to the relatively small group sample sizes. If the normality assumption was not met, we performed a Kruskal-Wallis test followed by a post-hoc Dunn test using the Bonferroni error correction. If the normality assumption was met, we then conducted a homogeneity test using a Levene test to assess whether the samples were from populations with equal variances. If the samples were not homogeneous, we ran a Welch analysis of variance (ANOVA) and a Games-Howell post-hoc test. If the samples were homogeneous, we ran a basic ANOVA test with a Tukey post-hoc test. For each measure, we analyzed the composite scores associated with each scale. For the emotion measures, we analyzed emotions individually and overall positive and negative composites.

V. RESULTS

The present study investigated the effects of different intervention conditions on various psychological outcomes, including emotions, future self-continuity, agency, optimism, future consideration, self-esteem, self-reflection, and insight. Participants were randomly assigned to one of four conditions: FutureYou (Condition 1, 73 participants), Questionnaire (Condition 2, 76 participants), Chat (Condition 3, 103 participants), or Control (Condition 4, 92 participants).

Δ Negative Emotion: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.004$). There was a significant effect of intervention condition on change in negative emotion at the $p<.001$ level [$F(3,181.60)=8.84$, $p<0.001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the FutureYou condition ($M=-0.63$, $SD=1.20$) was significantly different than the Control condition ($M=0.07$, $SD=0.77$, $p=0.001$) and the Questionnaire condition ($M=-0.07$, $SD=1.19$, $p=0.003$). The Chat condition ($M=-0.38$, $SD=0.82$) also differed significantly from Control ($p=0.009$).

Δ Anxious: A one-way ANOVA was conducted to compare the effect of intervention condition on change in anxiety levels. The assumption of homogeneity of variances was met (Levene’s test, $p=0.068$). There was a significant effect of intervention condition on change in anxiety at the $p<.01$ level [$F(3,376)=5.13$, $p=0.002$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change in anxiety for the FutureYou condition ($M=-0.68$, $SD=1.52$) was significantly different than the Control condition ($M=0.21$, $SD=1.10$, $p=0.001$) and the Questionnaire condition ($M=-0.04$, $SD=1.77$, $p=0.040$), and marginally different than the Chat condition ($M=-0.12$, $SD=1.50$, $p=0.059$).

Δ Unmotivated: A Welch one-way ANOVA was conducted

due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.002$). There was a significant effect of intervention condition on change in feeling unmotivated at the $p<.001$ level [$F(3,182.92)=9.62$, $p<0.001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the FutureYou condition ($M=-0.77$, $SD=1.75$) was significantly different than the Control condition ($M=0.15$, $SD=0.98$, $p=0.001$) and the Questionnaire condition ($M=-0.14$, $SD=1.48$, $p=0.029$). The Chat condition ($M=-0.58$, $SD=1.26$) also differed significantly from Control ($p=0.001$).

Δ Overwhelmed: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.047$). There was no significant effect of intervention condition on change in feeling overwhelmed at the $p<.05$ level [$F(3,185.98)=2.24$, $p=0.085$].

Δ Positive Emotion: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.004$). There was no significant effect of intervention condition on change in positive emotion at the $p<.05$ level [$F(3,183.84)=2.32$, $p=0.077$].

Δ Future Self Continuity: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p<0.001$). There was a significant effect of intervention condition on overall change in FSC at the $p<.001$ level [$F(3,172.18)=8.57$, $p<0.001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the FutureYou condition ($M=0.42$, $SD=0.70$) was significantly different than the Control condition ($M=-0.00$, $SD=0.35$, $p=0.001$), Chat condition ($M=0.06$, $SD=0.42$, $p=0.001$), and Questionnaire condition ($M=0.22$, $SD=0.64$, $p=0.040$). The Questionnaire condition also differed significantly from Control ($p=0.040$). Looking more closely at the specific sub-scales of Future Self Continuity:

Δ Future Self Continuity - Similarity: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p<0.001$). There was a significant effect of intervention condition on change in FSC similarity at the $p<.001$ level [$F(3,173.60)=7.45$, $p<0.001$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the FutureYou condition ($M=0.58$, $SD=1.08$) was significantly different than the Control condition ($M=-0.06$, $SD=0.52$, $p=0.001$), Chat condition ($M=0.03$, $SD=0.56$, $p=0.001$), and Questionnaire condition ($M=0.13$, $SD=0.83$, $p=0.002$).

Δ Future Self Continuity - Vividness: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p<0.001$). There was a significant effect of intervention condition on change in FSC vividness at the $p<.01$ level [$F(3,175.00)=4.38$, $p=0.005$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the FutureYou condition ($M=0.47$, $SD=0.84$) was significantly different than the Chat condition ($M=0.15$, $SD=0.59$, $p=0.017$) and Control condition ($M=0.10$, $SD=0.49$, $p=0.006$).

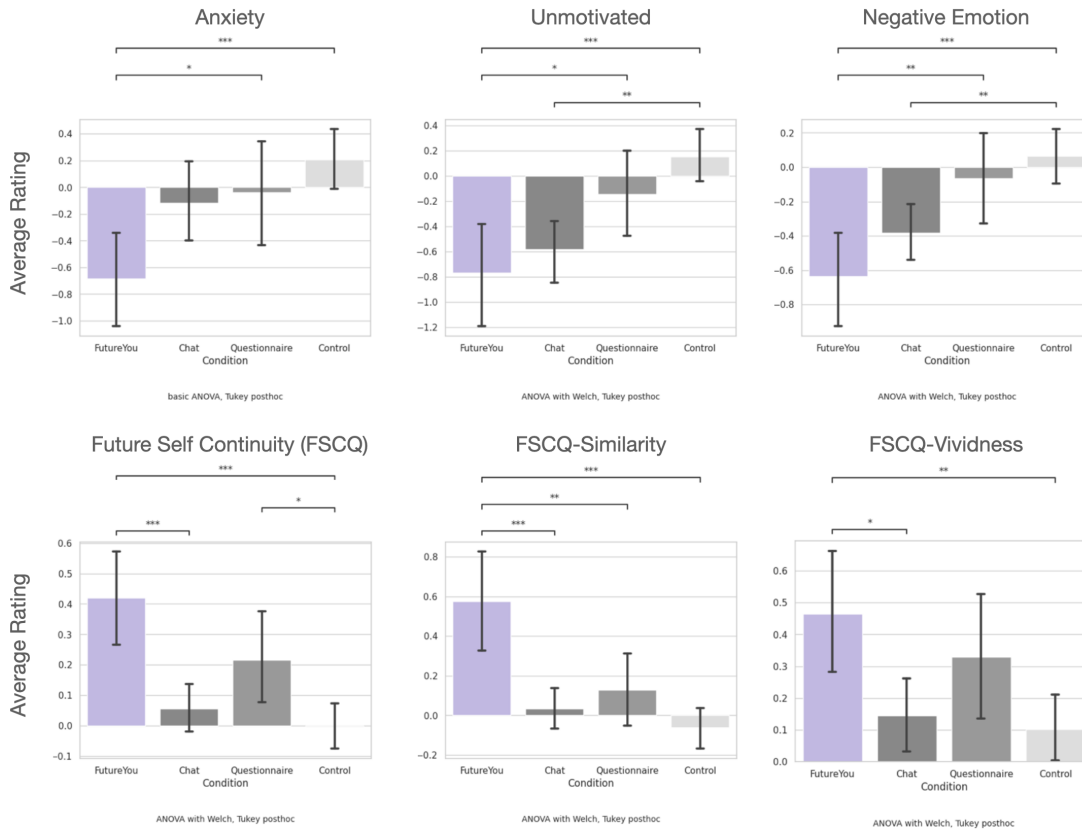


Fig. 3. After interacting with the “Future You” character, users reported decreased anxiety, and increased future self-continuity. This is the first study successfully demonstrating the use of personalized AI-generated characters to improve users’ future self-continuity and wellbeing.

Δ Future Self Continuity - Positivity: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.005$). There was no significant effect of intervention condition on change in FSC positivity at the $p<.05$ level [$F(3,173.18)=2.55$, $p=0.057$].

Δ Future Consideration: Future Consideration: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.018$). There was no significant effect of intervention condition on change in composite future consideration at the $p<.05$ level [$F(3,184.72)=1.19$, $p=0.314$].

Δ Self-Esteem, Δ Agency, and Δ Optimism: A Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.006$). There was no significant effect of intervention condition on change in composite self-esteem at the $p<.05$ level [$F(3,183.36)=1.21$, $p=0.308$]. For Agency, a Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.024$). There was a significant effect of intervention condition on change in composite agency at the $p<.01$ level [$F(3,183.19)=4.68$, $p=0.004$]. Post hoc comparisons using the Tukey HSD test indicated that the mean change for the Control condition ($M=-0.12$, $SD=0.57$) was significantly lower than the Chat condition ($M=0.20$, $SD=0.67$, $p=0.009$). For optimism, a Welch one-way ANOVA was conducted due to violation of the homogeneity of variances assumption (Levene’s test, $p=0.006$). There was no significant effect of intervention condition on change in composite

optimism at the $p<.05$ level [$F(3,181.43)=1.50$, $p=0.217$].

Δ Self-Reflection and Δ Insight: one-way ANOVA was conducted to compare the effect of intervention condition on change in composite self-reflection. The assumption of homogeneity of variances was met (Levene’s test, $p=0.203$). There was no significant effect of intervention condition on change in composite self-reflection at the $p<.05$ level [$F(3,376)=0.47$, $p=0.703$]. For insight, a one-way ANOVA was conducted to compare the effect of intervention condition on change in composite insight. The assumption of homogeneity of variances was met (Levene’s test, $p=0.783$). There was no significant effect of intervention condition on change in composite insight at the $p<.05$ level [$F(3,376)=0.69$, $p=0.557$].

VI. DISCUSSION

Could a conversation with a future self demonstrably impact feelings and self-continuity? In this study, we developed an interaction-based intervention to explore how interacting with a realistic future self could benefit users. The study yielded two key findings: immediately following the intervention, participants who interacted with their AI-generated future self reported significantly (1) decreased negative affect, including lowered anxiety; and (2) increased future self-continuity.

Qualitatively, users emphasized how emotional of an experience the intervention was when commenting about the interaction, expressing positive feelings such as comfort, warmth, and solace, and most users also reported that the chat interaction was enjoyable. Most users also reported that

Measure	Homogeneity	ANOVA Type	F-statistic	p-value	FutureYou	Chat	Questionnaire	Control
Positive Emotion	No	Welch	2.321	0.0769	0.20 ± 0.99	0.01 ± 0.67	-0.18 ± 0.79	0.05 ± 0.52
Negative Emotion	No	Welch	8.835	1.76e-05****	-0.63 ± 1.20	-0.38 ± 0.82	-0.07 ± 1.19	0.07 ± 0.77
Anxious	Yes	One-way	5.134	0.0017**	-0.68 ± 1.52	-0.12 ± 1.50	-0.04 ± 1.77	0.21 ± 1.10
Overwhelmed	No	Welch	2.245	0.0848	-0.45 ± 1.74	-0.45 ± 1.10	-0.01 ± 1.36	-0.16 ± 1.26
Unmotivated	No	Welch	9.618	6.58e-06****	-0.77 ± 1.75	-0.58 ± 1.26	-0.14 ± 1.48	0.15 ± 0.98
Agency	No	Welch	4.677	0.0036**	0.10 ± 0.79	0.20 ± 0.67	0.00 ± 0.83	-0.12 ± 0.57
Optimism	No	Welch	1.497	0.2171	0.24 ± 0.89	0.26 ± 0.54	0.14 ± 0.90	0.09 ± 0.66
FSCQ 1 (Similarity)	No	Welch	7.446	0.0001***	0.58 ± 1.08	0.03 ± 0.56	0.13 ± 0.83	-0.06 ± 0.52
FSCQ 2 (Vividness)	No	Welch	4.377	0.0054**	0.47 ± 0.84	0.15 ± 0.59	0.33 ± 0.90	0.10 ± 0.49
FSCQ 3 (Positivity)	No	Welch	2.551	0.0573	0.22 ± 0.88	-0.01 ± 0.68	0.19 ± 0.92	-0.05 ± 0.60
Future Self Continuity	No	Welch	8.571	2.49e-05****	0.42 ± 0.70	0.06 ± 0.42	0.22 ± 0.64	-0.00 ± 0.35
Future Consideration	No	Welch	1.192	0.3145	-0.01 ± 0.63	0.09 ± 0.50	0.19 ± 0.75	0.04 ± 0.62
Self-Esteem	No	Welch	1.209	0.3079	0.10 ± 0.76	0.10 ± 0.55	0.06 ± 0.75	-0.03 ± 0.45
Self-Reflection	Yes	One-way	0.471	0.7030	-0.04 ± 0.82	0.02 ± 0.55	0.08 ± 0.75	-0.03 ± 0.70
Insight	Yes	One-way	0.692	0.5574	0.03 ± 0.73	0.04 ± 0.68	-0.07 ± 0.66	-0.07 ± 0.65

*p<0.05; **p<0.01; ***p<0.001; ****p<0.0001

TABLE I

ANOVA RESULTS WITHOUT POST-HOC ANALYSIS. MEASURES VIOLATING THE EQUAL VARIANCES ASSUMPTION USED WELCH'S ANOVA. MEANS (M) AND STANDARD DEVIATIONS (SD) ARE PROVIDED FOR EACH CONDITION.

the chat interaction felt artificial, but not insincere, and that the interaction still felt conversational. This intervention thus contributes to a growing recognition of the potential for positive emotional interactions between humans and AI-generated virtual characters, despite their artificiality. Qualitatively, users also reported that they liked their future self, and noted that even though they perceived the life of their future self as different from their present life, they observed that their values and beliefs seemed consistent. As such, our intervention may help to combat the end-of-history illusion (the tendency to underestimate how much one's future self will change from their present selves) in helping users realize that although the details of their lives may change drastically, their core identities can remain true [33]. Even so, our intervention did not strengthen an individual's sense of positive affect regarding their future self.

Quantitatively, our intervention demonstrated that a brief, real-time, web-based intervention shows promise in helping users build a closer relationship with their ideal future self. Specifically, our intervention was successful in strengthening an individual's overall sense of future self-continuity, including the similarity, vividness, and positivity subscales of future self-continuity. In iterating and designing the Future You conversational style, we sought to use linguistic cues to signal continuity and similarity between the user's future and present self (e.g. saying "when I was your age..." and noting similarities between their perception of their past goals and the user's present goals). We also sought to present users with a vivid, narrated and visualized version of their future selves via the sharing of synthetic memories and an age-progressed photo. In doing so, we hoped to increase the accessibility of this future self intervention by eliminating the need for the user to imagine their continuous future self image and story by themselves. Our study thus demonstrates that a single, brief conversation can improve an individual's sense of future self-continuity, and present a version of the future self that is vivid and similar to the user without the need for embodiment. Future work should seek to isolate and understand the specific

linguistic cues, and narrative and visual features that create these effects on similarity and vividness.

The current research results also suggest that an interactive future self-continuity intervention could not only improve user mood and perception of their future, but intent to act towards their goals, as composite agency increased for those in the experimental condition. This suggests a potential mechanism through which agency (as it is related to hope) may work: by fostering a sense of similarity towards an idealized version of their future self, and building a connected and continuous relationship with their idealized future self, the user may view their goals as closer to their present than before. Our intervention also showed that it is not enough for interactions to feel conversational or open to dialogue to strengthen the positive affect with which users feel that they can picture their future selves, indicating that the social aspects of the intervention may not be relevant to how the interaction affects users emotionally. Because the Future You intervention also did not increase a general experience of positive affect, future work should focus on isolating the specific psychological and interactive mechanisms through which Future You may target the future self's likability, in order to ensure maximum impact of the intervention on future self-continuity.

VII. LIMITATIONS & ETHICAL CONSIDERATION

Our work opens new possibilities for AI-powered, interactive future self interventions, but there are limitations to address. Future research should: directly compare our Future You intervention with other validated interventions; examine the longitudinal effects of using the Future You platform; leverage more sophisticated ML models to potentially increase realism; and consider how interacting with a future self might reconstruct personal decisions as interpersonal ones between present and future selves as a psychological mechanism that explains treatment effects. Potential misuses of AI-generated future selves to be mindful of include: inaccurately depicting the future in a way that harmfully influences present behavior; endorsing negative behaviors; and hyper-personalization that reduces real human relationships and adversely impacts

health. These challenges are part of a broader conversation on the ethics of human-AI interaction and AI-generated media happening at both personal and policy levels. Researchers must further investigate and ensure the ethical use of this technology.

VIII. CONCLUSION

Imagine you could time travel 30 years into the future. What questions would you ask your future self? Our "Future You" intervention demonstrates a brief, real-time, web-based intervention that shows promise in helping users build a closer relationship with their ideal future self. By chatting with a relatable yet virtual version of their future selves in real time via a personalized large language model (GPT-3.5) and age-progressed portrait, users experienced reduced negative emotions such as anxiety and unmotivated feelings, and significantly increased future-self continuity compared. These findings highlight the potential of an AI-generated future self to help motivate and support the envisioning of one's future. We hope that our work will inspire more research in HCI that focuses on fostering future self-continuity and healthier, future-oriented decision making.

REFERENCES

- [1] H. Ersner-Hershfield, M. T. Garton, K. Ballard, G. R. Samanez-Larkin, and B. Knutson, "Don't stop thinking about tomorrow: Individual differences in future self-continuity account for saving," *Judgment and Decision making*, vol. 4, no. 4, p. 280, 2009.
- [2] H. E. Hershfield, "Future self-continuity: How conceptions of the future self transform intertemporal choice," *Annals of the New York Academy of Sciences*, vol. 1235, no. 1, pp. 30–43, 2011.
- [3] J.-L. Van Gelder, H. E. Hershfield, and L. F. Nordgren, "Vividness of the future self predicts delinquency," *Psychological science*, vol. 24, no. 6, pp. 974–980, 2013.
- [4] Y. Sokol and M. Serper, "Development and validation of a future self-continuity questionnaire: A preliminary report," *Journal of Personality Assessment*, 2019.
- [5] B. Ganschow, L. Cornet, S. Zebel, and J.-L. Van Gelder, "Looking back from the future: Perspective taking in virtual reality increases future self-continuity," *Frontiers in psychology*, p. 2204, 2021.
- [6] E. Pronin and L. Ross, "Temporal differences in trait self-ascription: when the self is seen as an other," *Journal of personality and social psychology*, vol. 90, no. 2, p. 197, 2006.
- [7] Y. Chishima and A. E. Wilson, "Conversation with a future self: A letter-exchange exercise enhances student self-continuity, career planning, and academic thinking," *Self and Identity*, vol. 20, no. 5, pp. 646–671, 2021.
- [8] Y. Chishima, I.-T. Huai-Ching Liu, and A. E. Wilson, "Temporal distancing during the covid-19 pandemic: Letter writing with future self can mitigate negative affect," *Applied Psychology: Health and Well-Being*, vol. 13, no. 2, pp. 406–418, 2021.
- [9] G. M. Lucas, J. Gratch, A. King, and L.-P. Morency, "It's only a computer: Virtual humans increase willingness to disclose," *Computers in Human Behavior*, vol. 37, pp. 94–100, 2014.
- [10] F.-T. Hong, L. Zhang, L. Shen, and D. Xu, "Depth-aware generative adversarial network for talking head video generation," *arXiv preprint arXiv:2203.06605*, 2022.
- [11] F. Yin, Y. Zhang, X. Cun, M. Cao, Y. Fan, X. Wang, Q. Bai, B. Wu, J. Wang, and Y. Yang, "Styleheat: One-shot high-resolution editable talking face generation via pretrained stylegan," *arXiv preprint arXiv:2203.04036*, 2022.
- [12] E. Zakharov, A. Shysheya, E. Burkov, and V. Lempitsky, "Few-shot adversarial learning of realistic neural talking head models," in *Proceedings of the IEEE/CVF international conference on computer vision*, 2019, pp. 9459–9468.
- [13] S. Yao, R. Zhong, Y. Yan, G. Zhai, and X. Yang, "Dfa-nerf: Personalized talking head generation via disentangled face attributes neural rendering," *arXiv preprint arXiv:2201.00791*, 2022.
- [14] X. Liu, Y. Xu, Q. Wu, H. Zhou, W. Wu, and B. Zhou, "Semantic-aware implicit neural audio-driven video portrait generation," *arXiv preprint arXiv:2201.07786*, 2022.
- [15] Y. Guo, K. Chen, S. Liang, Y.-J. Liu, H. Bao, and J. Zhang, "Adnerf: Audio driven neural radiance fields for talking head synthesis," in *Proceedings of the IEEE/CVF International Conference on Computer Vision*, 2021, pp. 5784–5794.
- [16] S. Burns, "Documentary 'welcome to chechnya' takes us behind the lines of a genocide," 2020, <https://www.wbur.org/artery/2020/06/30/welcome-to-chechnya-review/>, Last accessed on 2020-06-24.
- [17] D. Takahashi, "Deepdub uses ai to localize voice dubbing for foreign language films," <https://venturebeat.com/2020/12/16/deepdub-uses-ai-to-localize-dubbing-for-foreign-language-films/>, 2020, accessed: 2021-04-15.
- [18] The Dali Museum, "Dali lives (via artificial intelligence)," 2020, <https://thedali.org/exhibit/dali-lives/>, Last accessed on 2020-06-24.
- [19] J. Steinhauer, "Nostalgia on demand," in *History, Disrupted*. Springer, 2022, pp. 33–41.
- [20] G. M. Lucas, A. Rizzo, J. Gratch, S. Scherer, G. Stratou, J. Boberg, and L.-P. Morency, "Reporting mental health symptoms: breaking down barriers to care with virtual human interviewers," *Frontiers in Robotics and AI*, vol. 4, p. 51, 2017.
- [21] A. N. Vaidyam, H. Wisniewski, J. D. Halamka, M. S. Kashavan, and J. B. Torous, "Chatbots and conversational agents in mental health: a review of the psychiatric landscape," *The Canadian Journal of Psychiatry*, vol. 64, no. 7, pp. 456–464, 2019.
- [22] K. K. Fitzpatrick, A. Darcy, and M. Vierhile, "Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (woebot): a randomized controlled trial," *JMIR mental health*, vol. 4, no. 2, p. e7785, 2017.
- [23] A. A. Abd-Alrazaq, M. Alajlani, A. A. Alalwan, B. M. Bewick, P. Gardner, and M. Househ, "An overview of the features of chatbots in mental health: A scoping review," *International Journal of Medical Informatics*, vol. 132, p. 103978, 2019.
- [24] H. E. Hershfield, D. G. Goldstein, W. F. Sharpe, J. Fox, L. Yeykelis, L. L. Carstensen, and J. N. Bailenson, "Increasing saving behavior through age-progressed renderings of the future self," *Journal of marketing research*, vol. 48, no. SPL, pp. S23–S37, 2011.
- [25] T. Sims, S. Raposo, J. N. Bailenson, and L. L. Carstensen, "The future is now: Age-progressed images motivate community college students to prepare for their financial futures," *Journal of Experimental Psychology: Applied*, vol. 26, no. 4, p. 593, 2020.
- [26] J. D. Robalino, A. Fishbane, D. G. Goldstein, and H. E. Hershfield, "Saving for retirement: A real-world test of whether seeing photos of one's future self encourages contributions," *Behavioral Science & Policy*, vol. 9, no. 1, pp. 1–9, 2023. [Online]. Available: <https://doi.org/10.1177/23794607231190607>
- [27] J.-L. Van Gelder, L. J. Cornet, N. P. Zwalua, E. C. Mertens, and J. van der Schalk, "Interaction with the future self in virtual reality reduces self-defeating behavior in a sample of convicted offenders," *Scientific reports*, vol. 12, no. 1, pp. 1–9, 2022.
- [28] O. Patashnik, Z. Wu, E. Shechtman, D. Cohen-Or, and D. Lischinski, "Styleclip: Text-driven manipulation of stylegan imagery," in *Proceedings of the IEEE/CVF International Conference on Computer Vision*, 2021, pp. 2085–2094.
- [29] Y. Oda, R. Takano, T. Abe, and K. Kikuchi, "Development of the emotion and arousal checklist (eacl)," *The Japanese Journal of Psychology*, vol. 85, no. 6, pp. 579–589, 2015.
- [30] R. A. Millstein, W.-J. Chung, B. B. Hoepfner, J. K. Boehm, S. R. Legler, C. A. Mastromauro, and J. C. Huffman, "Development of the state optimism measure," *General Hospital Psychiatry*, vol. 58, pp. 83–93, 2019.
- [31] P. J. Silvia, "The self-reflection and insight scale: Applying item response theory to craft an efficient short form," *Current Psychology*, vol. 41, no. 12, pp. 8635–8645, 2022.
- [32] C. Snyder, C. Harris, J. Anderson, S. Holleran, L. Irving, S. Sigmon *et al.*, "Adult hope scale (ahs)," *Journal of Personality and Social Psychology*, vol. 60, pp. 570–585, 2007.
- [33] J. Quoidbach, D. T. Gilbert, and T. D. Wilson, "The end of history illusion," *science*, vol. 339, no. 6115, pp. 96–98, 2013.