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AI as a companion or a tool? Nostalgia promotes embracing AI technology with a relational use

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ABSTRACT

Recent research has indicated that nostalgia is associated with, or fosters, favorable responses to innovative technology and in particular artificial intelligence (AI). However, prior studies failed to differentiate between the relational and functional uses of AI agents, resulting in an incomplete understanding of the role that nostalgia plays in facilitating acceptance of innovation. The current research seeks to fill this gap. We hypothesized that nostalgia is associated with, or engenders, more favorable responses to AI agents used for relational purposes (i.e., as companions) than functional purposes (i.e., as tools for task completion). We obtained support for this moderation model in three preregistered studies ($\Sigma N = 1100$). Nostalgia was associated with (Study 1) or increased (Studies 2 and 3) favorability toward AI agents with a relational, but not functional, use. This pattern was due to the stronger role of nostalgia-induced social connectedness in predicting favorable responses to AI agents with a relational (vs. functional) use (Study 3). We discuss implications for the human-technology interaction.

1. Introduction

The rapid development of technology is juxtaposed with a yearning for the past, resulting in a thriving market for retro-technology products such as vinyl, CDs, and vintage-style headphones (Asmelash, 2022; Liao, 2019; Ryan, 2024). This phenomenon is reflected in empirical research, which indicates that the use of innovative technological products, such as smartphones, can trigger nostalgia (Huang et al., 2023). Novel products frequently evoke perceived loss of control (Faraji-Rad et al., 2017; Jhang et al., 2012), and people can reassure themselves by reflecting on their past (Huang et al., 2023).

Given that new technology can trigger nostalgia, it is informative to consider how nostalgia influences responses to technological innovation. Although some research suggests that nostalgia may act as a barrier to embracing innovation (Fleury et al., 2021; Hsieh, 2019; Reisenwitz et al., 2007), other research indicates that nostalgia promotes the adoption of new products (Xia et al., 2021; Zhou et al., 2021). Recent findings (Dang et al., 2024) have revealed that, in addition to promoting skepticism about change, nostalgia, by fostering social connectedness, aides in positive responding to innovative technology, and in particular to Artificial Intelligence (AI). AI agents can be used for relational purposes (e.g., as companions) or functional purposes (e.g., as tools for completing tasks). This multifaceted role of AI agents distinguishes them from the new products examined in earlier research (e.g., novel food flavors, machines with cutting-edge design features; Xia et al., 2021; Zhou et al., 2021) and other functional technologies (e.g., 5G, genetic engineering). Consequently, an important and yet underexplored question arises: Does nostalgia promote more favorable responses when AI agents are used for relational versus functional purposes? Furthermore, are such responses transmitted by social connectedness? We addressed these questions in the current article.

Specifically, by integrating the social character of nostalgia (Abakoumkin et al., 2020; Abeyta, Routledge, & Juhl, 2015; Juhl & Biskas, 2023; Sedikides & Wildschut, 2019, 2024) and attachment theory (Gillath & Karantzas, 2019; Mikulincer & Shaver, 2020), we propose that nostalgia bolsters a sense of connection with one's social environment, which, in turn, make people more open to exploring AI meant to sustain sociality. Consequently, nostalgia acts as a psychological source of promoting favorable responses to AI with relational (rather than functional) features. As the utilization of AI products with both relational and functional features (e.g., virtual assistants, ChatGPT) continues to rise in society (Statista, 2024; Tong, 2023), the current research

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carries both theoretical and practical significance. It clarifies whether nostalgia-instigated favorability toward AI products depends on their use pattern, thereby advancing understanding of the functions of nostalgia in embracing innovation. Additionally, the current research offers insights into strategies for promoting AI adoption through the framing of use (relational vs. functional) patterns.

1.1. Nostalgia and social connectedness

Nostalgia is a sentimental longing for one's meaningful past (Hepper et al., 2012; Sedikides & Wildschut, 2018). Nostalgic reverie can be triggered by the fond and tender recollections of events, objects, or persons from one's childhood, momentous occasions (e.g., graduations, weddings, birthday celebrations), cultural rituals that highlight the temporal continuity of one's life (e.g., Thanksgiving celebrations, festivals), interactions with close others (e.g., friends, partners, relatives), scents, tastes or foods, songs or music, and visual stimuli such as adverts or reading material (Abeyta, Routledge, Roylance, et al., 2015; Dai et al., 2024; Reid et al., 2015; Reid et al., 2023; Sedikides et al., 2022; Wildschut & Sedikides, 2023a, 2023b; Yang et al., 2021; Yin et al., 2023). Nostalgia is bittersweet: it encompasses contentment, positive affect, happiness, and joy, but also often negative affect and yearning for the lost past (Hepper et al., 2014; Sedikides & Wildschut, 2016; Van Tilburg et al., 2019). Yet, the emotion is more positive than negative (Leunissen, 2023; Van Tilburg, 2023). For example, people high (than low) on trait nostalgia rate their past favorably (Batcho, 1998), and people in an experimentally-induced state of nostalgia (vs. control) evaluate their past selves positively (Osborn et al., 2022). Also, nostalgia induces more positive affect than negative affect (Leunissen et al., 2021; Turner & Stanley, 2021). The emotion is experienced frequently (i.e., several times a week; Hepper et al., 2021; Wildschut et al., 2006), and by individuals across ages (Juhl et al., 2020; Madoglou et al., 2020) and cultures (Hepper et al., 2024; Li et al., 2024; Sedikides & Wildschut, 2022).

One's meaningful past, the fodder of nostalgia, is predominantly social. As mentioned above, this past includes close others or events in which the individual is encircled by close others. Indeed, individuals high (than low) on trait nostalgia recall memories that are mostly social (e.g., interpersonal) in nature (Abakoumkin et al., 2020; Abeyta, Routledge, & Juhl, 2015; Sedikides & Wildschut, 2024). Additionally, these individuals report higher intimacy maintenance (i.e., attaining symbolic proximity to intimate but absent persons) relative to individuals who endorse alternative ways of pondering their past like brooding, reflection, or counterfactual thinking (Cheung et al., 2018; Jiang et al., 2021).

Moreover, the social character of nostalgia is manifested in its association with *social connectedness* (Juhl & Biskas, 2023; Sedikides & Wildschut, 2019). This concept refers to perceived psychological closeness with one's social environment and to a general sense of belongingness and acceptance (Gabriel & Schneider, 2024; Lee & Robbins, 1995, 1998). It comprises indicators of relatedness-need satisfaction like feeling connected with close others, protected, socially supported, loved, and trusting others (Hirsch & Clark, 2019; Wildschut et al., 2010; Zhou et al., 2008). Importantly, when experimentally manipulated, nostalgia increases social connectedness referring to familiar persons (Dang & Liu, 2023; Wildschut et al., 2006) and ingroups (Abakoumkin et al., 2017; Wildschut et al., 2014) as well as to marginalized (Turner et al., 2018, 2022) and unfamiliar (Zhou et al., 2012) outgroups. To summarize, nostalgia bolsters social connectedness.

1.2. Social connectedness promotes favorability to AI with a relational use

Social connectedness functions as a psychological resource for personal growth and interpersonal exploration (Feeney & Collins, 2015; Mikulincer & Shaver, 2020). Attachment theory suggests that a sense of being loved, protected, and socially supported enables individuals to perceive themselves as capable of overcoming challenges and effectively navigating their social environments (Ainsworth, 1991; Bowlby, 1988; Mikulincer & Shaver, 2023). Confidence in one's social ability reinforces the goal of broadening social networks (Abeyta, Routledge, & Juhl, 2015; Dang & Liu, 2023). To achieve this goal, socially connected individuals engage in social interactions with new people, including strangers (Dang & Liu, 2023; Feeney et al., 2008) and outgroups (Kunstman et al., 2013). Notably, technological agents that are designed with, or perceived to entail, social cues (e.g., humanlike appearance, mental capability) can also providing social connection (Chen et al., 2020; Li & Sung, 2021). Consequently, social connectedness can encourage greater engagement with specific technological products. For example, a sense of belongingness heightens individuals' interest in interacting with companion robots and robot recipients (Dang & Liu, 2024a).

AI, a typical innovative technology, has transcended its traditional role as a mere tool for task completion; social interactions with AI now offer novel experiences (Yam et al., 2024). AI is "a growing resource of interactive, autonomous, self-learning agency, which enables computational artifacts to perform tasks that otherwise would require human intelligence to be executed successfully" (Taddeo & Floridi, 2018, p. 751). It manifests in various forms such as natural language processing, robotics, neural networks, and virtual assistants. People interact with AI agents for two distinct purposes (de Graaf et al., 2018; Xu & Li, 2024). One purpose is functional; people can treat AI agents as tools for task completion (Davis, 1989; Davis et al., 1989). For example, people employ industrial robots to enhance productivity in manufacturing processes and implement AI assistants for tasks such as searching, navigation, or scheduling (Amar et al., 2022; Heidt, 2023). The other purpose is relational; people can treat AI agents as social actors and develop personal relationships with them (Nass & Moon, 2000; Reeves & Nass, 1996). For example, AI voice assistants can hold conversations with users and offer emotional support, fostering companionship (Acikgoz et al., 2023; Ki et al., 2020). The differentiation between relational and functional use is relevant not only to different AI agents (e.g., companion robots vs. industrial robots) but also to the same AI agent. For example, ChatGPT can serve as a companion engaging with end-users (Alessa & Al-Khalifa, 2023; Horsey, 2023) and as a tool for end-users to inquire and gather information (Vallance, 2022).

Given that the relational use of AI involves forming social bonds with it, social connectedness facilitates the acceptance of AI agents in relational contexts. For example, participants in an experimentally-induced state of social connectedness (vs. control) reported greater support for research on companion robots and robot recipients, which are designed to engage with humans (Dang & Liu, 2024a). This finding aligns with previous research indicating that social connectedness strengthens the endorsement of technological services, such as graphic-based emoticons that render conversations more friendly in instant messaging (Jung et al., 2022). In contrast, social connectedness does not heighten enthusiasm for interacting with functionally designed machines (e.g., a clock), leading to fewer humanlike traits being attributed to them (Bartz et al., 2016).

1.3. The current research

Given that nostalgia bolsters social connectedness and that social connectedness promotes embracing AI agents with a relational use, nostalgia may facilitate favorable responses to AI agents when these are implemented for relational rather than functional purposes. Stated otherwise, we hypothesize that the influence of nostalgia (dispositional or induced) on favorability to AI is more pronounced for agents whose use is relational than functional (*Hypothesis 1*). Preliminary evidence points in this direction for our hypothesis: Nostalgia leads to overall favorable attitudes toward technological products that entail social cues, like companion robots, but not toward those lacking explicit social cues, like 5G technology (Dang et al., 2024). Furthermore, we hypothesize

that social connectedness accounts for this proposed moderation effect, with the indirect pathway from nostalgia to responses to AI through heightened social connectedness being stronger for AI agents with a relational use (*Hypothesis 2*).

We tested our hypotheses in three studies. In Study 1, we assessed trait nostalgia and examined the moderating role of relational (vs. functional) use in the association between nostalgia and responses to ChatGPT. In Studies 2 and 3, we experimentally manipulated nostalgia and examined its influence on responses to robots and ChatGPT characterized by relational (vs. functional) use. In Study 3, we tested directly whether social connectedness accounts for the moderation pattern. For generalizability, we recruited both Chinese (Studies 1 and 2) and British (Study 3) participants. We diversified the manipulations of nostalgia and relational use across Studies 2 and 3. Further, we operationalized responses to AI as support for research on and adoption of ChatGPT (Study 1), behavioral support for, and favorable ratings of, Jibo robots (Study 2), and attitudes toward ChatGPT (Study 3).

2. Study 1

In Study 1, we engaged in a first test of Hypothesis 1, namely, that AI use moderates the association between nostalgia and responses to innovative technology. Given the increased popularity of large language models (Sallam, 2023; Van Dis et al., 2023), we focused on responses to ChatGPT, an established exemplar of such models. These models have been designed with mental capabilities comparable to humans (King, 2023; Wang et al., 2023). We manipulated relational (vs. functional) use by asking participants to list how ChatGPT can be implemented to offer companionship (vs. complete tasks). Hypothesis 1 stated that nostalgia would be associated with favorable AI attitudes (i.e., support for ChatGPT research) and behavioral intentions (i.e., GPT adoption, that is, preference for it over real persons) among participants who considered ChatGPT an agent of companionship (relational use condition), but that this association would be reduced or cancelled out among participants who considered ChatGPT an agent of task completion (functional use condition).

2.1. Method

2.1.1. Participants

An a priori power analysis indicated that a sample size of $N = 202$ would afford 80 % power to detect a small interaction effect of $R^2 = 0.030$ in a linear multiple regression model with three predictors (nostalgia, AI use, and their interaction; da Silva Frost & Ledgerwood, 2020; Faul et al., 2007). We conservatively recruited 307 Chinese participants via the online platform Credamo, paying each 3 CNY. Seven participants who failed an attention check were automatically excluded by the platform. The final sample comprised 300 participants (189 women, 111 men) ranging in age from 18 to 58 years ($M = 30.57$, $SD = 8.70$). A sensitivity power analysis indicated that the sample size would provide 80 % power to detect an effect of $R^2 = 0.026$ or greater in a multiple regression analysis with three predictors. We randomly assigned them to one of the two AI use conditions: relational use ($n = 150$) or functional use ($n = 150$).

2.1.2. Materials and procedure

2.1.2.1. Trait Nostalgia. Participants completed the 7-item Southampton Nostalgia Scale (Sedikides, Wildschut, Routledge, & Arndt, 2015; Wildschut et al., 2023), preceded by a definition of nostalgia ("sentimental longing for one's past"). Four items referred to frequency of nostalgic engagement (e.g., "How often do you experience nostalgia?"; 1 = *very rarely*, 7 = *very frequently*), and three to the extent to which participants consider nostalgia personally relevant (e.g., "How valuable is nostalgia for you?"; 1 = *not at all*, 7 = *very much*). We averaged responses to form a nostalgia index (α = 0.89).

2.1.2.2. ChatGPT use manipulation. Participants first read a brief description of large language models, including ChatGPT, for refreshment or familiarization reasons. Then, they were introduced to the manipulation. In the relational use condition, they read that ChatGPT "can provide users with meaningful emotional feedback." Four examples followed, such as: "when users feel lonely or stressed, they can engage in conversation with ChatGPT and find companionship." In the functional use condition, participants read that ChatGPT "can enhance users' work and learning efficiency." Four examples followed, such as: "ChatGPT can act as an information resource, providing users with the necessary information and advice they seek." Next, participants took at least 2 min to write down how they had used or would use ChatGPT as an agent for relational purposes or functional purposes, depending on condition.[1]

2.1.2.3. Support for ChatGPT research. Participants responded to three items gauging attitudinal support for ChatGPT research (Dang et al., 2024). A sample item is: "To what extent do you support increasing state funding for research on ChatGPT?" (1 = *not at all*, 7 = *very much*; α = 0.77).

2.1.2.4. ChatGPT adoption. Participants responded to items gauging behavioral intentions toward ChatGPT. Specifically, they were informed of six contexts wherein they could prefer either ChatGPT or real persons (e.g., "If you were a consumer, would you prefer to follow a personalized product recommendation by ChatGPT or a customer service staff when shopping online?"; Sallam, 2023). Participants indicated which option—ChatGPT or real persons—they would prefer in each context. We coded a preference for "ChatGPT" as 1 and a preference for real persons as 0. The total number of contexts in which participants preferred ChatGPT instead of a real person constituted the relevant index (range = 0–6).

2.1.3. Transparency and openness

Study 1 was preregistered at https://tinyurl.com/34xe59z9. We made the data available at https://tinyurl.com/nn69as53. We provide the research protocol and exploratory factor analyses on the scale items in the Online Supplement. We report how we determined our sample size, all data exclusions, all manipulations, and all measures in this study (and subsequent ones; Kazak, 2018).

2.2. Results and discussion

We report descriptive statistics and intercorrelations in Table 1.

We applied the Process macro (Hayes, 2022; Model 1) to examine the role of relational use versus functional use in the association between trait nostalgia and responses to ChatGPT. We tested a moderation model

Table 1
Descriptive statistics and zero-order correlations among variables in Study 1.

Variable	*M* (*SD*)	2	3	4
1. Trait Nostalgia	5.01 (0.99)	−0.02	0.31***	0.11
2. ChatGPT Use Manipulation	0.50 (0.50)		0.01	0.14*
3. Support for ChatGPT Research	5.46 (0.92)			0.35***
4. ChatGPT Adoption	3.09 (1.56)			–

Note. ChatGPT Use Manipulation: relational use = 1, functional use = 0. *$p < .05$. ***$p < .001$.

[1] Two participants did not follow instructions, with one writing nothing and the other writing "AI is powerful." The results remained unchanged when we excluded these two participants from analyses.

for support for ChatGPT research and ChatGPT adoption, respectively. The moderation analysis revealed that nostalgia positively predicted support for ChatGPT research, $b = 0.25$, 95 % CI [0.15, 0.35], $SE = 0.05$, $t(296) = 5.06$, $p < .001$. Participants in the relational use condition reported less support for such research than those in the functional use condition, $b = -1.25$, 95 % CI [−1.75, −0.75], $SE = 0.26$, $t(296) = -4.89$, $p < .001$. More importantly, the interaction effect was significant, $b = 0.25$, 95 % CI [0.15, 0.35], $SE = 0.05$, $t(296) = 5.03$, $p < .001$. Simple slope analyses (left panel in Fig. 1) indicated that nostalgia positively predicted support for ChatGPT research in the relational use condition ($b = 0.51$, 95 % CI [0.38, 0.64], $SE = 0.07$, $t(296) = 7.68$, $p < .001$), but not in the functional use condition ($b = 0.00$, 95 % CI [−0.15, 0.15], $SE = 0.08$, $t(296) = 0.02$, $p = .986$).

A similar analysis on ChatGPT adoption revealed no overall effects of nostalgia ($b = 0.15$, 95 % CI [−0.03, 0.33], $SE = 0.09$, $t(296) = 1.63$, $p = .104$) and ChatGPT use ($b = -0.64$, 95 % CI [−1.55, 0.27], $SE = 0.46$, $t(296) = -1.38$, $p = .169$). The crucial interaction, however, was trending ($b = 0.17$, 95 % CI [−0.01, 0.35], $SE = 0.09$, $t(296) = 1.89$, $p = .059$). Simple slope analyses (right panel in Fig. 1) indicated that nostalgia positively predicted ChatGPT adoption in the relational use condition ($b = 0.32$, 95 % CI [0.09, 0.56], $SE = 0.12$, $t(296) = 2.68$, $p = .008$), but not in the functional use condition ($b = -0.02$, 95 % CI [−0.30, 0.25], $SE = 0.14$, $t(296) = -0.17$, $p = .862$).

The results are consistent with the hypothesis. When participants considered ChatGPT as a means of companionship, those who were high (than low) on nostalgia expressed more support for research on it and stronger intentions to adopt it (over preferring real persons). However, participants high and low on nostalgia did not differ in their responses to ChatGPT when considering it merely as a task completion tool. Importantly, these results imply that nostalgia prepares people to accept AI when framed relationally. This is in line with previous work suggesting that nostalgia constitutes the springboard for responding proactively to the social environment (Abeyta, Routledge, & Juhl, 2015; Dang & Liu, 2023).

3. Study 2

In Study 2, we aimed to test the replicability of Study 1 findings and extend them. First, we manipulated, rather than measure, nostalgia. Second, we used a different AI application, Jibo robots, for generalizability reasons. We described Jibo robots in the relational use condition as family partners and in the functional use condition as tools for various tasks. We hypothesized that nostalgia would increase favorable responses to Jibo robots among participants who considered them as family partners (relational use condition), but this effect would be reduced or cancelled out among participants who considered them tools for various tasks (functional use condition).

3.1. Method

3.1.1. Participants

We employed a 2 (nostalgia: nostalgia, control) × 2 (AI use: relational, functional) between-subjects design. In Study 1, interaction effects between trait nostalgia and AI (ChatGPT) use were $R^2 = 0.071$ for support for ChatGPT research, and $R^2 = 0.012$ for ChatGPT adoption. Based on a small effect size in this range ($\eta^2 = 0.020$) and $\alpha = 0.05$, an a priori power analysis indicated that an N of 387 would provide 80 % power to detect the interaction effect between nostalgia and AI use in a four-condition experiment (da Silva Frost & Ledgerwood, 2020; Faul et al., 2007). Hedging against attrition, we recruited 411 Chinese participants through Credamo, remunerating each with 5 CNY. The platform excluded 11 participants who failed the attention check. The final sample consisted of 400 participants (216 women, 184 men) ranging in age from 18 to 62 years ($M = 30.17$, $SD = 7.82$). A sensitivity power analysis indicated that the sample size would provide 80 % power to detect an effect of $\eta^2 = 0.019$ or greater in a 2 × 2 between-subjects ANOVA.

3.1.2. Materials and procedure

3.1.2.1. Nostalgia manipulation. We manipulated the emotion with an adapted version of the Nostalgia Prototype Induction (Dang et al., 2024, Study 4; see also Wildschut & Sedikides, 2025). Participants first saw pictures of nostalgic objects or neutral objects and then, correspondingly, viewed centrally prototypic or peripherally prototypic features of nostalgia (Hepper et al., 2012, 2014). Next, depending on condition, they recalled an event that was relevant to at least one object and was characterized by at least five features. They spent five minutes imagining that they returned to this event and wrote a brief description of it and their experiences as they remembered it. All participants followed instructions, leading to no exclusions. A 3-item manipulation check followed (Wildschut et al., 2006). A sample item is: "I feel nostalgic at the moment" (1 = *strongly disagree*, 7 = *strongly agree*; $\alpha = 0.92$).

3.1.2.2. Robot use manipulation. Participants read a description intended to familiarize them with Jibo robots. Subsequently, they viewed pictures (Fig. 2) and descriptions regarding different uses of such robots. Specifically, in the relational use condition, they read that "the Jibo robot is used to interact with family members and provide companionship and support" such as interactive communication, participation in family activities, and educational interaction. In the functional use condition, they read that "the Jibo robot can enhance efficiency in both home and work environments" such as home automation, schedule management, and work support.

3.1.2.3. Attitudes toward Jibo robots. Participants indicated the extent to which they considered Jibo robots attractive, efficient, strong, and trustworthy (Epley et al., 2008; 1 = *not at all*, 7 = *totally*; $\alpha = 0.65$[2]). The traits appeared in a different random order for each participant.

3.1.2.4. Behavioral support for Jibo robots. We assessed behavioral support for Jibo robots with a paradigm developed by Venus et al. (2019, Study 2) and later adapted by Dang et al. (2024a, Study 1B). Participants were informed that a Science and Technology Club was planning to launch an exhibition whose purpose was to allow public access to Jibo robots. The Club intended to stir public interest in the form of letters. In particular, the Club needed participants to prepare a letter. They were instructed to draft a letter to be as long or short as they wanted it to be. We counted the number of characters in the letter as a behavioral indicator of support for innovative technology.[3]

3.1.3. Transparency and openness

The study was preregistered at https://aspredicted.org/KJM_BHS. We made the data available at https://tinyurl.com/nn69as53. We provide the research protocol and exploratory factor analyses on the scale items in the Online Supplement.

3.2. Results and discussion

Participants in the nostalgia condition ($M = 6.20$, $SD = 0.71$) reported feeling more nostalgic than controls ($M = 4.85$, $SD = 1.55$), $F(1,$

[2] Epley et al. (2008) reported an alpha of 0.71.

[3] We analyzed the content of these letters. Sixteen participants returned empty letters, which we coded with a word count of 0. Eleven participants expressed expectations for additional functions in future Jibo robots (e.g., "Hope Jibo robots can be better at understanding human emotions"). The remaining 373 participants listed benefits of Jibo robots (e.g., "Jibo can promote wellbeing in our life and work!") or encouraged further exploration of Jibo robots and innovative technology (e.g., "Let's embrace innovative technology and interact with Jibo robots!").

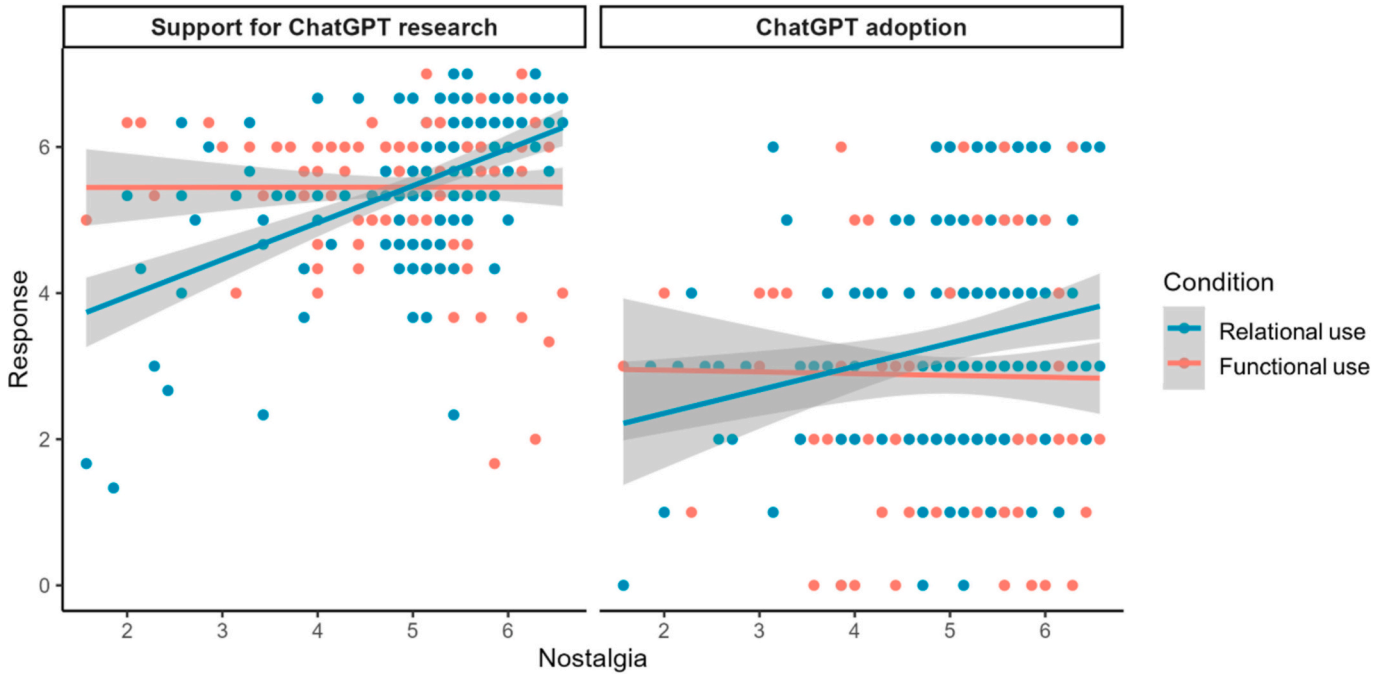

Fig. 1. Association of Nostalgia with responses to ChatGPT as a function of ChatGPT use in Study 1.
Note. Gray shading indicates standard errors.

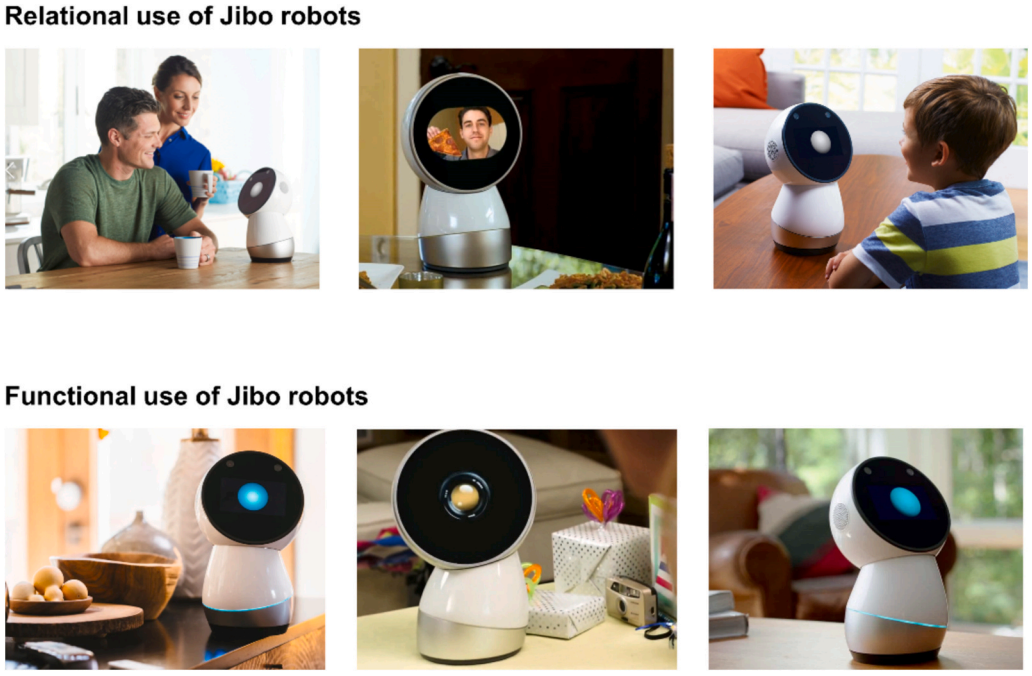

Fig. 2. Pictures depicting relational or functional use of Jibo Robots in Study 2.

398) = 125.54, $p < .001$, $\eta^2 = 0.240$, 90 % CI [0.182, 0.296]. The nostalgia manipulation was effective.

We conducted a 2 × 2 between-subjects Analysis of Variance (ANOVA) on attitudes toward Jibo robots. Neither the main effect of nostalgia, $F(1, 396) = 1.16$, $p = .282$, $\eta^2 = 0.003$, 90 % CI [0.000, 0.018], nor the main effect of AI use, $F(1, 396) = 0.10$, $p = .751$, $\eta^2 < 0.001$, 90 % CI [0.000, 0.008], was significant. The interaction of interest, however, was significant, $F(1, 396) = 4.21$, $p = .041$, $\eta^2 = 0.011$, 90 % CI [0.001, 0.033]. Simple effects analyses (left panel in Fig. 3) indicated that, in the relational use condition, nostalgic participants ($M = 5.84$, $SD = 0.44$) expressed a more favorable attitude toward Jibo robots than controls ($M = 5.65$, $SD = 0.66$), $F(1, 396) = 4.90$, $p = .028$, $\eta^2 = 0.012$, 90 % CI [0.001, 0.036], but, in the functional use condition, nostalgic ($M = 5.70$, $SD = 0.59$) and control ($M = 5.76$, $SD = 0.65$) participants did not differ in their favorability toward Jibo robots to $F(1, 396) = 0.47$, $p = .492$, $\eta^2 = 0.001$, 90 % CI [0.000, 0.013]. Alternatively, nostalgic participants tended to express a more favorable attitude toward Jibo robots in the relational use than functional use condition, $F(1, 396) = 2.80$, $p = .095$, $\eta^2 = 0.007$, 90 % CI [0.000, 0.027], whereas control participants did not differ in their favorability toward Jibo

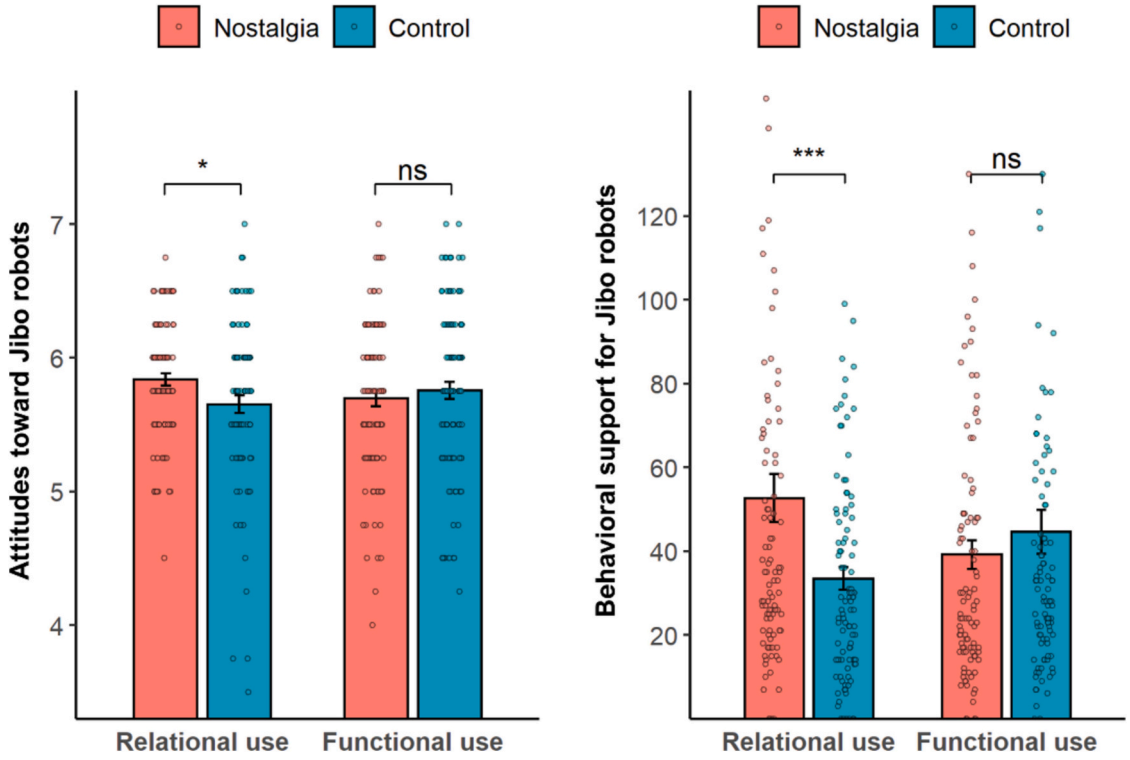

Fig. 3. Attitudes toward and behavioral support for Jibo robots as a function of Nostalgia and AI Use in Study 2.
Note. $*p < .05$. $***p < .001$. ns = non-significant.

robots across conditions, $F(1, 396) = 1.50$, $p = .221$, $\eta^2 = 0.004$, 90 % CI [0.000, 0.020].

We conducted a similar ANOVA on behavioral support for Jibo robots. The main effect of nostalgia was trending, $F(1, 396) = 3.71$, $p = .055$, $\eta^2 = 0.009$, 90 % CI [0.000, 0.031], and the main effect of AI use was not significant, $F(1, 396) = 0.44$, $p = .508$, $\eta^2 = 0.001$. The critical interaction, however, was significant, $F(1, 396) = 9.81$, $p = .002$, $\eta^2 = 0.024$, 90 % CI [0.005, 0.054]. Simple effects analyses (right panel in Fig. 3) showed that, in the relational use condition, nostalgic participants ($M = 56.29$, $SD = 58.76$) expressed stronger behavioral support for Jibo robots (i.e., wrote longer endorsements) than controls ($M = 33.49$, $SD = 27.03$), $F(1, 396) = 12.79$, $p < .001$, $\eta^2 = 0.031$, 90 % CI [0.009, 0.064]. However, in the functional use condition, nostalgic ($M = 39.19$, $SD = 34.15$) and controls ($M = 44.62$, $SD = 52.70$ participants did not differ in their expressions of behavioral support for Jibo robots, $F(1, 396) = 0.73$, $p = .395$, $\eta^2 = 0.002$, 90 % CI [0.000, 0.016]. Alternatively, nostalgic participants expressed stronger behavioral support for Jibo robots in the relational use than functional use condition, $F(1, 396) = 7.20$, $p = .008$, $\eta^2 = 0.018$, 90 % CI [0.003, 0.045], whereas control condition participants did not differ in their expression of behavioral support for Jibo robots across the two kinds of use, $F(1, 396) = 3.05$, $p = .082$, $\eta^2 = 0.008$, 90 % CI [0.000, 0.028].[4]

By simultaneously manipulating nostalgia and AI use, we demonstrated that relational use enhanced the impact of nostalgia (vs. control) on responses to Jibo robots. Functional use did not enhance the influence of nostalgia (vs. control) on responses to Jibo robots. These results are consistent with the Study 1 findings. Moreover, relational (vs. functional) use fostered behavioral support for Jibo robots among participants who were momentarily nostalgic, instead of diminish support for Jibo robots among control participants. We observed a similar pattern in the ratings of Jibo robots, but directionally rather than significantly.

[4] Number of characters was positively skewed (skewness = 3.50). In an ancillary analysis, we normalized the variable "behavioral support for Jibo robots" by deriving the natural logarithm. Consistent with results on untransformed scores, the interaction was significant, $F(1, 396) = 8.28$, $p = .004$, $\eta^2 = 0.020$, 90 % CI [0.004, 0.049]). Simple effects analyses showed that, in the relational use condition, nostalgic participants ($M = 3.58$, $SD = 1.08$) expressed stronger behavioral support for Jibo robots than controls ($M = 3.10$, $SD = 1.09$), $F(1, 396) = 10.75$, $p = .001$, $\eta^2 = 0.026$, 90 % CI [0.007, 0.058]. However, in the functional use condition, nostalgic ($M = 3.27$, $SD = 1.03$) and controls ($M = 3.38$, $SD = 0.94$) participants did not show a significant difference in their expression of behavioral support for Jibo robots, $F(1, 396) = 0.63$, $p = .429$, $\eta^2 = 0.002$, 90 % CI [0.000, 0.015]. Alternatively, nostalgic participants expressed stronger behavioral support for Jibo robots in the relational use than functional use condition, $F(1, 396) = 4.58$, $p = .033$, $\eta^2 = 0.011$, 90 % CI [0.001, 0.035], whereas control participants did not show a significant difference in their expression of behavioral support for Jibo robots regardless of AI use, $F(1, 396) = 3.72$, $p = .054$, $\eta^2 = 0.009$, 90 % CI [0.000, 0.031].

4. Study 3

We had two objectives in Study 3. From a methodological standpoint, we aimed to test our hypothesis with British participants instead of Chinese participants for generalizability reasons, given that prior research showed cultural differences in attitudes toward AI technology (Dang & Liu, 2021). We also implemented a different nostalgia manipulation. From a theoretical standpoint, we directly tested social connectedness as an explanation for our findings (Hypothesis 2). We predicted that the indirect pathway from nostalgia to responses to AI through heightened social connectedness would be stronger when AI products were used for relational purposes rather than functional purposes.

4.1. Method

4.1.1. Participants

We employed a 2 (nostalgia: nostalgia, control) × 2 (AI use: relational, functional) between-subjects design. The average size of the interaction effects between nostalgia and AI use that we obtained in Studies 1 and 2 was $\eta^2 = 0.032$. Based on this effect size and $\alpha = 0.05$, an a priori power analysis indicated that an *N* of 240 would provide 80 % power to detect an interaction effect in a 4-condition experiment (da Silva Frost & Ledgerwood, 2020; Faul et al., 2007). Considering that we would also test the mediating role of social connectedness, we aimed for an *N* of 400. We recruited 411 British participants via Prolific, paying each 1 GBP. The platform excluded 11 participants for failing the attention check. The final sample comprised 400 participants (224 women, 171 men, 5 unreported) ranging in age between 18 and 77 years ($M = 40.93$, $SD = 13.77$). Of them, 84.8 % (339) were White, 6.0 % (24) were Asian/Asian British, 4.0 % (16) were if Mixed ethnicity, 3.8 % (15) were Black/African British, and 1.5 % (6) reported Other. A sensitivity power analysis indicated that the sample size would provide 80 % power to detect an effect of $\eta^2 = 0.019$ or greater in a 2 × 2 between-subjects ANOVA.

4.1.2. Materials and procedure

4.1.2.1. Nostalgia manipulation. We manipulated the emotion with a song search paradigm developed by Abeyta, Routledge, & Juhl, 2015; see also: Abeyta & Routledge, 2016; Sedikides et al., 2022). We randomly assigned participants to the nostalgia or control condition. In both conditions, participants conducted a YouTube search for a song. In the nostalgia condition, participants read a definition of nostalgia ("a sentimental longing for the past"). Participants then searched for and listened to a song that made them feel nostalgic. In the control condition, participants only searched for and listened to a song that they recently discovered and enjoy listening to. To ensure task completion, we instructed participants to enter the Internet address for the song, the most nostalgic lyrics or their favorite lyrics in the song (depending on condition), and the duration of the song. Next, participants wrote about how the song made them feel and responded to the manipulation check ($\alpha = 0.92$), as in Study 2.[5]

4.1.2.2. Social connectedness. We assessed social connectedness with the 4-item social connectedness subscale of the Nostalgia Functions Scale (Hepper et al., 2012; e.g., "connected to loved ones"; 1 = *strongly disagree*, 7 = *strongly agree*) preceded by the stem "Listening to this song makes me feel …." ($\alpha = 0.91$).

4.1.2.3. ChatGPT use manipulation. We manipulated ChatGPT Use by presenting participants with descriptions regarding how ChatGPT provides support for people who prepare a job application. In the relational use scenario, ChatGPT alleviated anxiety through emotional validation, encouragement, and motivation, as well as listening and empathy. In the functional use scenario, ChatGPT aided in refining application letters through information gathering, resume and application letter assistance, as well as interview preparation.

4.1.2.4. Attitudes toward ChatGPT. We assessed attitudes toward ChatGPT for a job application with five items that we developed (e.g., "How comfortable would you feel relying on ChatGPT to prepare a job application?"; 1 = *very uncomfortable*, 7 = *very comfortable*). After reverse-scoring a negatively-word item, we averaged responses to form an index ($\alpha = 0.89$).

4.1.3. Transparency and openness

The study was preregistered at https://aspredicted.org/23Q_N57. We made the data available at https://tinyurl.com/nn69as53. We provide the research protocol and exploratory factor analyses on the scale items in the Online Supplement.

4.2. Results

Participants in the nostalgia condition ($M = 5.77$, $SD = 0.87$) reported feeling more nostalgic than controls ($M = 4.66$, $SD = 1.50$), $F(1, 398) = 81.15$, $p < .001$, $\eta^2 = 0.169$, 90 % CI [0.117, 0.224]. The nostalgia manipulation was successful.

We carried out a 2 × 2 between-subjects ANOVA on attitudes toward ChatGPT. The main effect of nostalgia, $F(1, 396) = 3.50$, $p = .062$, $\eta^2 = 0.009$, 90 % CI [0.000, 0.030], and that of ChatGPT use, $F(1, 396) = 3.40$, $p = .066$, $\eta^2 = 0.009$, 90 % CI [0.000, 0.030], were trending. Importantly, the interaction was significant, $F(1, 396) = 13.13$, $p < .001$, $\eta^2 = 0.032$, 90 % CI [0.010, 0.065]. Simple effects analyses (Fig. 4) revealed that, in the relational use condition, nostalgic participants ($M = 4.37$, $SD = 1.32$) reported more favorable attitudes toward ChatGPT than controls ($M = 3.57$, $SD = 1.49$), $F(1, 396) = 15.09$, $p < .001$, $\eta^2 = 0.037$, 90 % CI [0.012, 0.072]. However, in the functional use condition, nostalgic participants ($M = 3.58$, $SD = 1.55$) and controls ($M = 3.83$, $SD = 1.42$) did not differ in their favorability of attitudes toward ChatGPT, $F(1, 396) = 1.54$, $p = .216$, $\eta^2 = 0.004$, 90 % CI [0.000, 0.021]. Alternatively, nostalgic participants reported more favorable attitudes toward ChatGPT in the relational than functional use condition, $F(1, 396) = 14.94$, $p < .001$, $\eta^2 = 0.036$, 90 % CI [0.012, 0.071], whereas control condition participants did not differ in their favorability toward ChatGPT across conditions, $F(1, 396) = 1.59$, $p = .209$, $\eta^2 = 0.004$, 90 % CI [0.000, 0.021].

To test the mediating role of social connectedness, we conducted a second-stage moderated mediation analysis using Process macro (Hayes, 2022; Model 15). In this model, ChatGPT use (relational vs. functional) moderated the role of social connectedness in predicting attitudes toward ChatGPT and also moderated the direct effect of nostalgia on attitudes toward ChatGPT.

As shown in Fig. 5, nostalgia bolstered social connectedness ($b = 0.63$, 95 % CI [0.36, 0.90], $SE = 0.14$, $t(398) = 4.62$, $p < .001$), which in turn positively predicted favorable attitudes toward ChatGPT ($b = 0.46$, 95 % CI [0.37, 0.56], $SE = 0.05$, $t(394) = 9.79$, $p < .001$). ChatGPT use (relational vs. functional) moderated the link between social connectedness and attitudes toward ChatGPT, $b = 0.42$, 95 % CI [0.24, 0.61], $SE = 0.09$, $t(394) = 4.46$, $p < .001$, with the positive prediction link being stronger in the relational use condition ($b = 0.68$, 95 % CI [0.54, 0.81], $SE = 0.07$, $t(394) = 9.63$, $p < .001$) than in the functional use condition ($b = 0.25$, 95 % CI [0.13, 0.38], $SE = 0.06$, $t(394) = 3.96$, $p < .001$). Therefore, the indirect path via social connectedness was moderated by ChatGPT use (moderated mediation index = 0.27, 95 % CI [0.13, 0.48],

[5] Four participants entered only "YouTube" but not the specific Internet address for the songs. Six participants wrote down the content of the song but not how the song made them feel. The results remained unchanged when we removed these 10 participants from analyses.

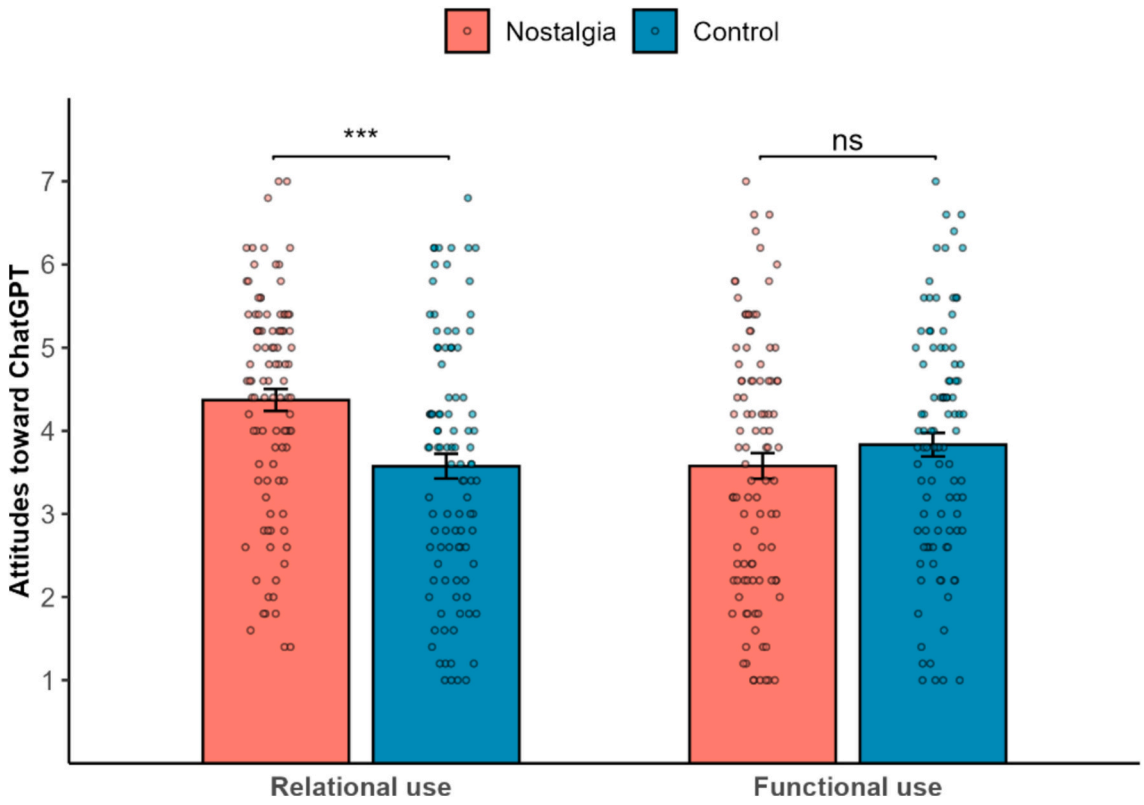

Fig. 4. Attitudes toward ChatGPT as a function of Nostalgia and AI use in Study 3.
Note. ***$p < .001$. ns = non-significant.

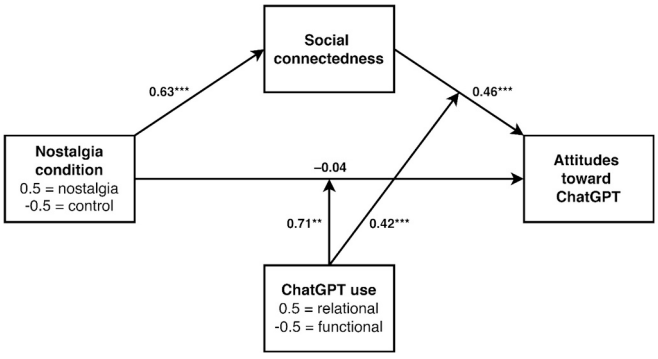

Fig. 5. Nostalgia's influence on attitudes toward ChatGPT via social connectedness in Study 3.
Note. Coefficients are unstandardized. ** $p < .01$. *** $p < .001$.

$SE = 0.09$), with the mediating effect being stronger in the relational use condition ($b = 0.43$, 95 % CI [0.24, 0.65], $SE = 0.10$) than in the functional use condition ($b = 0.16$, 95 % CI [0.06, 0.31], $SE = 0.06$).

After controlling for social connectedness, the residual direct effect of nostalgia on attitudes toward ChatGPT was not significant, $b = -0.04$, 95 % CI [−0.30, 0.22], $SE = 0.13$, $t(394) = -0.30$, $p = .767$. Notably, ChatGPT use moderated this residual direct effect, $b = 0.71$, 95 % CI [0.19, 1.23], $SE = 0.26$, $t(394) = 2.68$, $p = .008$. Specifically, nostalgia reduced positive attitudes toward ChatGPT in the functional use condition, $b = -0.39$, 95 % CI [−0.76, −0.03], $SE = 0.19$, $t(394) = -2.12$, $p = .034$, but this effect was trending in the opposite direction in the relational use condition, $b = 0.32$, 95 % CI [−0.06, 0.69], $SE = 0.19$, $t(394) = 1.67$, $p = .096$.

In Study 3, we replicated the findings of Studies 1 and 2 among British participants and with a different nostalgia manipulation. Crucially, we provided a more detailed explanation for why AI use moderates the effect of nostalgia on responses to AI by establishing social connectedness as a mediator.

5. General discussion

With the global development and spread of innovative technology, it is of theoretical and practical importance to investigate how nostalgia, a prevalent social emotion, influences attitudes and behaviors toward AI technology. We proposed and tested that relational (vs. functional) use moderates the influence of nostalgia on responses to AI. Across three studies, capturing trait and state (i.e., experimentally manipulated) nostalgia, using different AI agents (ChatGPT, Jibo robots) as well as distinct nostalgia manipulations, and relying on varying participant ethnicity (Chinese, British), nostalgia promoted the embracement of AI technology with a relational use.

Moreover, nostalgia had no significant impact when AI agents were designed for functional purposes. This aligns with findings pointing to a null effect of nostalgia on Chinese participants' preferences for contemporary foods (e.g., hamburger and sushi; Zhou et al., 2019), but contrasts with findings that nostalgia strengthens intentions to adopt new products such as foods with novel flavors, new formula toothpaste, and cameras with unique shapes (Xia et al., 2021; Zhou et al., 2021). In comparison to traditional consumer goods, AI agents represent a more advanced and powerful technology, leading to their perception not only as capable allies but also as formidable competitors (Dang & Liu, 2021). Ambivalence toward AI may be more pronounced among nostalgic individuals, as nostalgia can both encourage acceptance of and foster hesitation toward AI technology. This duality results in a neutral effect of nostalgia on AI agents intended for functional use (Dang et al., 2024; Dang et al., 2024b).

5.1. Theoretical and practical implications

Our findings contribute to the nascent literature on the influence of nostalgia upon innovation. Relevant work did not differentiate between technology usage patterns (Dang et al., 2024; Dang et al., 2024b; Xia et al., 2021; Zhou et al., 2021). Here, we examined whether nostalgia's influence on the human–AI interplay depends on the purposes for which AI agents are used. In doing so, we demonstrated that individuals characterized by higher trait nostalgia or transient nostalgia show greater endorsement of AI with a relational use. By focusing on the role of relational use in responses to innovative technology, we also extend findings suggesting that nostalgia encourages the adoption of retro products to which one is personally attached (Ju et al., 2017; Muehling et al., 2014; Zhou et al., 2019).

Our research increases understanding of how social connectedness influences human–technology interactions. Although social connectedness is known to buttress personal and interpersonal thriving (Feeney & Collins, 2015; Mikulincer & Shaver, 2020; Ryan & Deci, 2000, 2017), its link to the human–technology interplay has only recently been addressed (Dang & Liu, 2024a, 2024b; Jung et al., 2022; Mende et al., 2019). Building on this budding literature, we found that relational use strengthens the positive association between social connectedness and responses to AI. Put otherwise, feeling a sense of connection with others galvanizes engagement with technological products that entail companionship. These results contribute to attachment theory (Ainsworth, 1991; Bowlby, 1988; Mikulincer & Shaver, 2023) by highlighting that secure social relationships, which serve as a psychological resource for fostering social exploration, find a parallel in the relational use of AI technology. Moreover, our findings challenge proposals that feeling socially connected can cause detachment from humans and nonhuman entities (Bartz et al., 2016; Waytz & Epley, 2012). The nuanced impact of social connectedness warrants further investigation.

Our findings also have practical relevance. We found that nostalgia was associated to favorable responses to AI agents when they were purported to be used for relational than functional purposes. It is likely that for consumers who are prone to nostalgia, such as those who experience loneliness (Zhou et al., 2022), boredom (Van Tilburg et al., 2013), or self-discontinuity (i.e., disconnect between past and present selves; Sedikides et al., 2015), highlighting the social (vs. functional) aspects of AI products could be a successful marketing strategy. Furthermore, if AI agents are to be used relationally, adding nostalgia to the mix might be an effective way to encourage the public's adoption of innovative products. An example is Deep Nostalgia, an app using AI to animate photographed faces of loved ones and thus make them move, blink, and smile. Users are attracted to this technological product, as it revives memories by invigorating bonds with family members and friends (Gamillo, 2021).

5.2. Limitations and future directions

Some methodological limitations call for follow-up research. First, we treated functional use and relational use as two distinct routes to responses to AI technology, without considering their potential overlap. A recent study has indicated that relational use can increase subsequent functional use of AI voice assistants, whereas functional use can undermine relational use of AI voice assistants in the long run (Xu & Li, 2024). A longitudinal approach, then, could examine how nostalgia influences responses to AI agents over distinct uses. Second, future research could explore individual differences. For example, the influence of nostalgia on responses to relationally-used AI agents may be stronger among persons with interdependent than independent self-construal. Third, we focused on responses to ChatGPT and Jibo robots. Follow-up work could examine whether the findings are applicable to other AI agents (e.g., virtual assistants and autonomous vehicles). Finally, the replicability of the findings could be tested in other cultures, beyond the East Asian-Western divide (Vignoles et al., 2016).

Future investigations are needed to expand our theoretical framework. Previous research has established the causal relation between nostalgia and social connectedness, and between social connectedness and responses to technological innovation (Dang et al., 2024). Accordingly, we proposed and tested the mediating role of social connectedness in the effect of nostalgia on responses to AI. However, responses to AI may also influence social connectedness. Recent research has revealed that using AI agents with social intelligence fosters emotional attachment to the agents (Pantano & Scarpi, 2022). Conversely, some studies suggest that more frequent use of AI in the workplace is associated with higher levels of loneliness among anxiously attached users (Tang et al., 2023). Therefore, follow-up studies could contribute to our findings by clarifying the causal relationship between social connectedness and responses to AI technology.

6. Concluding remarks

Nostalgia can increase favorability toward AI. This depends, though, on whether AI products are approached as companions or tools for task completion. Nostalgia is more effective in the former instance, due to increases in social connectedness, than the latter instance. This research broadens understanding of the relations among an emotion (nostalgia), an experiential state (social connectedness), and attitudes or behavioral intentions toward innovation.

Declaration of generative AI and AI-assisted technologies in the writing process

We have not used any AI-assisted technologies during the preparation of this work.

Open practices

We preregistered the designs and data analysis plans of Study 1 (https://tinyurl.com/34xe59z9), Study 2 (https://aspredicted.org/KJM_BHS), and Study 3 (https://aspredicted.org/23Q_N57). We made all data available (https://tinyurl.com/nn69as53). Also, we provided stimulus materials in Online Supplement.

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CRediT authorship contribution statement

Jianning Dang: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Constantine Sedikides:** Writing – review & editing, Writing – original draft, Conceptualization. **Tim Wildschut:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Li Liu:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization.

Declaration of competing interest

There are no conflicts of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jesp.2024.104711.

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