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More Than a Barrier: Nostalgia Inhibits, but Also Promotes, Favorable Responses to Innovative Technology

Jianning Dang[1, 2], Constantine Sedikides[3], Tim Wildschut[3], and Li Liu[1, 2]
[1] Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University
[2] State Key Laboratory of Cognitive Neuroscience and Learning, Faculty of Psychology, Beijing Normal University
[3] Center for Research on Self and Identity, School of Psychology, University of Southampton

While technology is moving forward, people are looking back to the past. How does nostalgia influence responses (i.e., attitudes and behavior) to innovative technology? We postulated a dual-pathway model, according to which nostalgia, as a social emotion, would foster social connectedness that would be associated with or lead to favorable responses to innovative technology. At the same time, nostalgia, as an emotion that places a high premium on the past, would be associated with or lead to unfavorable responses to innovative technology (i.e., artificial intelligence or fifth-generation wireless communication) via skepticism about change. We provided support for the dual-pathway model in seven studies (N = 1,629), using correlational and experimental methods, operationalizing the constructs in diverse ways, and testing participants from three cultures (China, United Kingdom, and United States). The findings contribute to the vibrant conversation on human−technology relationship.

Keywords: nostalgia, social connectedness, skepticism about change, artificial intelligence, human−technology relationship

Supplemental materials: https://doi.org/10.1037/pspa0000368.supp

> Preserving the old ways from being abused
> Protecting the new ways for me and for you
> What more can we do
>
> —The Kinks, *The Village Green Preservation Society*
> (released in the U.K. on 11/22/1968)

Technological progress has been relentless. From the technology industry's perspective, newer is better (Duggal, 2021; Haefner et al., 2021). At the same time, the market for selling and buying retro-technology products (e.g., first-generation iPhones, dumbphones) is thriving, accompanied by growing consumer fascination with obsolete technology (Matyus, 2019). While technology is moving forward, consumers are looking back to the past. The phenomenon of diametrically opposing responses (i.e., attitudes and behavior) to tradition and innovation—a phenomenon The Kinks aptly identified—raises questions. Is there a paradox between yearning for the past and endorsing technological progress? Can this paradox be understood by introducing the construct of nostalgia? In particular, how does nostalgia, which places value on the past, influence responses to technological innovation?

It makes intuitive sense and is met with empirical verification, that the emotion of nostalgia is associated with lower willingness to adopt new technological products (Hsieh, 2019; Reisenwitz et al., 2007). People who cherish nostalgically the past may dwell on it (Morewedge, 2013; Strangleman, 1999) and be skeptical about change likely to be introduced by future-directed technology. However, other empirical streams appear to challenge this notion: Nostalgia may facilitate favorable responses to innovative technology. In particular, nostalgia fosters social connectedness (Juhl & Biskas, 2023; Sedikides & Wildschut, 2019), which serves as safe basis for welcoming innovative technology (Dang & Liu, 2023b; Jung et al., 2022).

These two seemingly contrasting theoretical and empirical streams call for a broader framework to understand the relevance

Jianning Dang https://orcid.org/0000-0002-8174-0136
Constantine Sedikides https://orcid.org/0000-0002-7563-306X
Tim Wildschut https://orcid.org/0000-0002-6499-5487
Li Liu https://orcid.org/0000-0002-4898-3013

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Correspondence concerning this article should be addressed to Li Liu, Beijing Key Laboratory of Applied Experimental Psychology, Faculty of Psychology, Beijing Normal University, Beijing, 100875, China. Email: l.liu@bnu.edu.cn

of nostalgia in responding to technological innovation. We postulate a model that integrates the dual property of nostalgia (i.e., being a past-oriented but forward-looking emotion) with evading and embracing technological innovation. Specifically, nostalgia is associated with or engenders evasion of technological innovation via higher skepticism about change, but is associated with or engenders embracement of technological innovation via greater social connectedness. As a recognizable innovative technology, artificial intelligence (AI) has considerably changed people's lives (Bonnefon et al., 2016; Williams, 2020). We focus, therefore, on responses to AI technology, although we also examine response to fifth-generation wireless communication (5G technology).

Our research makes both conceptual and practical contributions to the literature. From a conceptual standpoint, the research elucidates the dual property of nostalgia (as an emotion that is directed toward the past but is consequential for the future) and the ambivalent nature of responses to innovative technology. From a practical standpoint, by illustrating how nostalgia influences responses to AI technology, our research contributes to the vibrant conversation on human–technology relationships and on strategies to overcome psychological barriers to innovative technology. As an example of that conversation, a popular app called Deep Nostalgia, released by the genealogy platform MyHeritage in February 2021, uses a technique powered by AI to animate photographed faces of loved ones and thus help to invigorate bonds with family members and friends.

Nostalgia and Innovative Technology

Nostalgia is "a sentimental longing or wistful affection for the past" (*The New Oxford Dictionary of English*, Pearsall, 1998, p. 1266). The emotion can be evoked by the fond recollection of objects or events experienced in childhood, momentous occasions (e.g., graduation, anniversary), interactions with close others (e.g., friends, relatives), scents, tastes or foods, songs or music, and visual stimuli such as adverts or reading material (Dai et al., 2023; Reid et al., 2015, 2023; Sedikides et al., 2022; Wildschut & Sedikides, 2023a, 2023b; Yang et al., 2021). Nostalgic reverie entails contentment and joy, but also pining for the unattainability of the cherished past (Sedikides & Wildschut, 2016a; van Tilburg, 2023). The emotion, then, is bittersweet, as the nostalgizer reports mostly positive affect but also negative affect (Frankenbach et al., 2021; Leunissen et al., 2021; J. R. Turner & Stanley, 2021). Additionally, the emotion is self-relevant, as the nostalgizer brings to mind personally meaningful experiences (Sedikides & Wildschut, 2018; van Tilburg et al., 2018) that highlight the temporal continuity of their lives (Hong et al., 2021, 2022). Last, nostalgia is social, as the nostalgizer is symbolically surrounded in their recalled experiences by important others (Juhl & Biskas, 2023; Wildschut et al., 2006). The emotion is experienced frequently (i.e., several times a week; Hepper et al., 2021; Wildschut et al., 2006), and by persons of all ages (Juhl et al., 2020; Madoglou et al., 2017) and cultures (Sedikides & Wildschut, 2022; Wildschut et al., 2019).

Technological innovation entails original or substantially improved technological products or processes. As a recognizable innovative technology, AI refers to "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). That is, AI operates semi or fully autonomously to carry out tasks enacted traditionally by humans (Clarke, 2019). Examples of AI are robotics, digital assistants, self-driving cars, and neural networks. AI is deployed not only in industrial settings (e.g., industrial robots), but also in service (e.g., home cleaning robots, virtual assistants; Martínez-Plumed et al., 2021) and social (e.g., companion robots, AI avatars; Dilmegani, 2020; O'Hara, 2019) settings. Despite its diverse exemplars, the key characteristics of AI are inventiveness and future direction. These characteristics constitute a double-edged sword: The concern that the development of disruptive technology will surpass uncontrollably the human mind or reach can lead to repudiation of AI products (Dang & Liu, 2022a; Morewedge, 2022; Solberg et al., 2020), whereas the allure of novel technology can spark endorsement of AI products (Magni et al., 2010; Talaifar & Lowery, 2022; Yohanan & MacLean, 2012).

How does nostalgia influence responses to technological innovation? On the one hand, as nostalgia facilitates relishing the past (Batcho, 1998; Hepper et al., 2012; Osborn et al., 2022), it seems that nostalgia contributes to hesitancy toward innovative technology. On the other hand, as nostalgia affords psychological resources for facing and thriving in the future (FioRito & Routledge, 2020; Sedikides & Wildschut, 2016b, 2020), it is plausible that nostalgia conduces to embracement of innovative technology.

An Integrative Model of Nostalgia and Responses to Innovative Technology

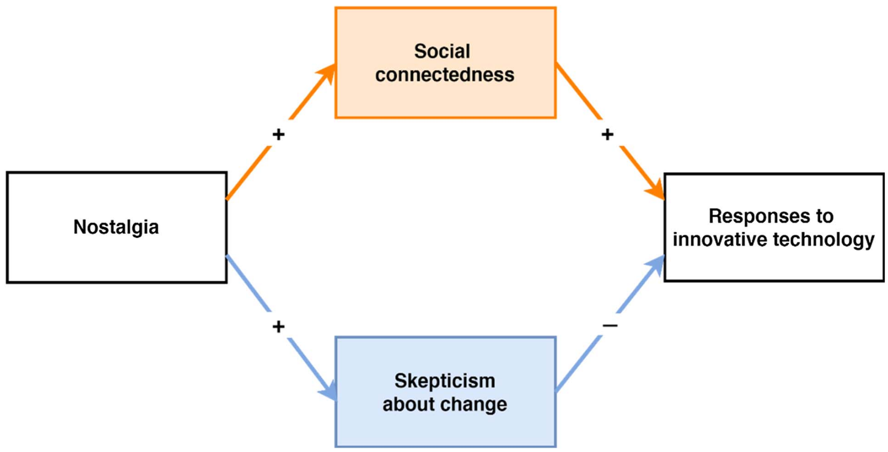
To reconcile these two competing perspectives, we formulated an integrative dual-pathway model in which two opposing mechanisms account for the influence of nostalgia on responses to innovative technology (Figure 1). Nostalgia is positively related to, or fosters, social connectedness, which, in turn, is associated with favorability toward technological innovation. At the same time, nostalgia is positively related to, or increases, skepticism about change, which, is associated with unfavorability toward technological innovation.

Nostalgia Conduces to Favorability Toward Innovative Technology

In nostalgic reverie, the future is often seen positively (Sedikides & Wildschut, 2020, 2023). Induced nostalgia strengthens one's perception of the self as ready to take on new challenges (W. Y. Cheung et al., 2013; Stephan et al., 2015). Notably, these psychological benefits for the self are rooted in nostalgia-elicited sociality or social connectedness (i.e., a sense of belongingness and acceptance; Sedikides et al., 2015; Sedikides & Wildschut, 2019). Specifically, increased social connectedness, by conducing to higher self-esteem, accounts for nostalgia's role in fostering positive expectations for the future (W. Y. Cheung et al., 2013, 2018; Stephan et al., 2015). Extending this literature to human–technology relationships, we advocate that nostalgia will contribute to embracement of technological innovation. We explicate below the likely mechanisms.

Nostalgia is a social emotion. It is positively associated with, and fosters, social connectedness (Juhl & Biskas, 2023; Sedikides & Wildschut, 2019). This concept refers, in particular, to the perception of closeness with one's social environment (Lee & Robbins, 1995, 1998), and encompasses various indicators of relatedness-need satisfaction, such as feeling loved, protected, socially supported or accepted, and connected with or trusting others (Hirsch & Clark, 2019; Wildschut et al., 2006, 2010). Memories of interpersonal

Figure 1
A Theoretical Model of Opposing Excitatory (via Social Connectedness) and Inhibitory (via Skepticism About Change) Pathways Linking Nostalgia With Responses to Innovative Technology



Note. See the online article for the color version of this figure.

relationships abound among individuals high on trait nostalgia (Abakoumkin et al., 2020; Abeyta et al., 2015; Batcho, 1998). Also, these individuals report greater intimacy maintenance (i.e., achieving symbolic proximity to close but absent others) compared to individuals high on alternative ways of thinking about one's past such as brooding, reflection, or counterfactual thinking (W. Y. Cheung et al., 2018; Jiang et al., 2021). Additionally, experimentally induced (i.e., state) nostalgia galvanizes social connectedness, as displayed in a sense of connection to close others (Wildschut et al., 2006) and ingroups (Abakoumkin et al., 2017) as well as perceived social support from social networks (Zhou et al., 2008).

Social connectedness entails approach-oriented outcomes. For example, people who recall experiences of social acceptance (vs. exclusion) report greater striving for deepening existing social relationships or establishing new ones (Dang & Liu, 2023a). Social connectedness facilitates the acquisition of new experiences (Ryan & Deci, 2000, 2017). Innovative technology represents a novel experiential domain. As such, social connectedness is presumed to be associated with or promote embracement of innovative technology. As a case in point, social connectedness strengthens one's interest in interacting with robots and support for research on robots (Dang & Liu, 2023b), increases favorable judgments about technological services (Jung et al., 2022), and decreases comfort when experiencing services provided by robots (Mende et al., 2019).

Nostalgia Conduces to Unfavorable Responses to Innovative Technology

In nostalgic reverie, the lived past is often seen through rose-colored glasses, comprising somewhat idealized scenes from family traditions, relational celebrations, personal achievements, or cultural rituals (Abeyta et al., 2015; Wildschut et al., 2006). Also, the past is regarded as a psychologically safe place in which to dwell (Fleury et al., 2021; Zhou et al., 2019), and nostalgizers often yearn or desire to return to this past (Lammers, 2023; Leunissen, 2023). Indeed, participants high (than low) on trait nostalgia rate their past favorably (Batcho, 1998), and participants in an experimentally induced state of nostalgia (vs. control) evaluate their past selves more favorably (Osborn et al., 2022).

The above reasoning implies that nostalgia will be at odds with technological innovation. More specifically, persons with a chronic proclivity toward nostalgic reflection, or those in transient nostalgia, will be more likely to hold unfavorable responses to innovative technology. There is some suggestive support for this notion. Older in age consumers who are high (than low) on trait nostalgia are often resistant to technological innovation: They have less experience with the internet and feel less comfortable using it (Choi & Dinitto, 2013; Friemel, 2016; Reisenwitz et al., 2007).

But how would nostalgia be associated with, or lead to, unfavorability toward innovative technology? We proposed that a critical mechanism is skepticism about change. Skepticism is “an attitude of doubt or a disposition to incredulity either in general or toward a particular object” (Merriam-Webster, 1986, p. 1103). Skepticism has been studied in conjunction with change, be it organizational (Stanley et al., 2005) or climatic (Ecklund et al., 2017). Here, we advocate that nostalgia, given its prizing of the past (Sedikides et al., 2015) and its association with brushing-off internet technology (Reisenwitz et al., 2007) or IT system implementation (Hsieh, 2019), will be related to, or kindle, skepticism about change in technological innovation. People who are skeptical about change may perceive inability to accurately predict or completely understand the trajectory of technology; this tendency is a major barrier in accepting innovative technology (Jahanmir & Cavadas, 2018; Mani & Chouk, 2018). Taken together, nostalgia is past-oriented and may breed skepticism about change, which in turn reinforces unfavorable responding to technological innovation.

Based on the above literature review and rationale, social connectedness and skepticism about change account for two opposing effects of nostalgia on responses to innovative technology (Figure 1). In statistical terms, the model involves two opposing mediational pathways. The total effect of nostalgia on responses to innovative technology refers to the effect *before* controlling for (or "removing") mediational pathways. The direct effect of nostalgia on responses to innovative technology refers to the residual effect *after* controlling for mediational pathways. The pathway through social connectedness is positive. Controlling for it will therefore produce a negative change in the direct effect (compared to the total effect). Conversely, the pathway through skepticism about change is negative, and controlling for it will produce a positive change in the direct effect (compared to the total effect). Assuming no other intervening processes, controlling simultaneously both pathways will eliminate the direct effect (even when the two pathways differ in magnitude); a residual direct effect would point to the operation of one or more additional, unmeasured processes. Further, assuming no other intervening processes, when the opposing mediational pathways have the same magnitude, there will be no total effect of the initial predictor (nostalgia) on the outcome (responses to innovative technology)—the opposing pathways will cancel out each other. However, when these two opposing pathways differ in magnitude, the total effect will be dominated by (i.e., have the same direction as) the stronger of the two pathways. Given that the literature does not speak to the relative strength of the opposing pathways, we were agnostic about the direction of nostalgia's total effect on responses to innovative technology.

Overview

We tested our hypothesized dual-pathway model through experimental-causal-chain design (Spencer et al., 2005) complemented by measurement-of-mediation design. In Studies 1A (replicated in Supplemental Studies S1 and S2) and 1B, we examined the causal influence of the hypothesized mediators (i.e., social connectedness and skepticism for change, respectively), on responses to innovative technology. In Study 2, we tested the dual-pathway model cross-sectionally: We assessed trait nostalgia, social connectedness, skepticism for change, and responses to innovative technology. Finally, in Studies 3 and 4, we tested the model experimentally: We manipulated nostalgia, and measured social connectedness, skepticism for change, and responses to innovative technology.

We used "responses to innovative technology" as an umbrella term for attitudinal or behavioral responses to AI technology. In particular, we operationalized attitudinal responses as quality of human–AI robot relationship (Study 1A), psychological closeness with AI robots (Supplemental Studies S1 and S2), support for research on AI technology (Studies 1B, 2, and 3), and support for research on companion robots (Study 4). We operationalized behavioral responses as behavioral support for AI technology (Study 1B), participation in research on AI technology (Study 3), and adoption of companion robots (Study 4).

We adopted several strategies to ensure the robustness of the results. First, we diversified the manipulations of nostalgia, and measurement of nostalgia, putative mediators, and outcomes. Second, we operationalized responses to innovative technology in several ways, as mentioned above. Third, we tested the hypothesized models across cultures, and in particular China (Studies 1A, Supplemental Study S1, 1B, 3, 4), the United Kingdom (Study 2), and the United States (Supplemental Study S2). Fourth, we addressed an alternative explanation, namely, that positive affect accounts for the hypothesized links, as it can be elicited by both nostalgia and social connectedness (Mikulincer & Shaver, 2001; van Tilburg et al., 2015). By controlling for positive affect (and, exploratorily, negative affect), we established the unique effects of nostalgia (Study 4) and social connectedness (Study 1A and Supplemental Study S1) on responses to innovative technology. Finally, we conducted an internal meta-analysis.

Transparency and Openness

We report how we determined our sample size, data exclusions, manipulations, and measures in the studies, and we follow Journal Article Reporting Standards (Kazak, 2018). We preregistered the hypotheses, design, and data analysis plans of all five studies that we report in the article on Open Science Framework: Study 1A (https://osf.io/urg6y/?view_only=d6292f80b7e54f3cad58b915aa1f43e9), Study 1B (https://osf.io/c8pkz/?view_only=0eaa0a52f17d43e6b1b8ca8a21fb6aa3), Study 2 (https://osf.io/fus72/?view_only=3b1852d13df0472d9b8ef70bec33d090), Study 3 (https://osf.io/fevjn/?view_only=7624a0995723452aa916d122ee1bc48d), Study 4 (https://osf.io/jwqy4/?view_only=ee5699a15c1441ec940e5f83682f5ccd). We note and explain deviations from preregistered analyses. We provide the following in Supplemental Material: stimulus materials; parallel analyses and exploratory factor analyses for all measures; correlations among the manipulation checks and measured variables; description of Supplemental Studies S1 and S2; analyses that control for positive affect (and negative affect) in Study 1A, Supplemental Study S1, and Study 4. We made data and analysis codes available at https://osf.io/4khxr/?view_only=71a8a41d65004cfa9d5a92ba17128e27.

Study 1A

In experimental Study 1A, we tested the causal effect of social connectedness on responses to innovative technology, operationalized as quality of human–AI robot relationship.

Method

Participants

A power analysis revealed that an N of 128 would suffice to achieve 80% power for detecting a medium-size effect (Cohen's d = 0.5) of social connectedness on quality of human–AI robot relationship (α = .05). Hedging against attrition (as we did in all studies), we planned to recruit 140 Chinese participants on ePanel. We ended up recruiting 142 participants remunerating each with 10 CNY (1.54 USD). We excluded one participant for quitting the study. The final N comprised 141 participants (75 women, 66 men; M_{age} = 23.91 years, SD_{age} = 5.56 years), whom we randomly assigned to the connectedness (n = 73) or control (n = 68) condition.

Procedure and Materials

Social Connectedness Manipulation. We manipulated social connectedness with a relationship visualization task (Mikulincer et al., 2005). In the high social connectedness condition, participants thought for a few minutes "of a person to whom you turn when you feel distressed or worried," and then listed six central qualities of that person. Afterward, they were instructed to "recall a specific situation in which this person actually comforted and helped you when you were feeling distressed or worried. Please write a brief description of that situation and the way you felt during it." In the control condition, participants thought of "a person you know but with whom you do not have a close relationship (an acquaintance)" and afterward were instructed to "recall a specific situation in which you interacted with this person." The manipulation check followed. Participants viewed the stem "Recalling this person makes me feel … " and then responded to five items (W. Y. Cheung et al., 2013; Hepper et al., 2012; Zhou et al., 2008): "protected," "connected to loved ones," "supported," "warm," "loved" (1 = *strongly disagree*, 7 = *strongly agree*; $\alpha = .94$).

Quality of Human–AI Robot Relationship. We measured this construct with four items adapted from Riketta (2005; e.g., "In general, the relationship between humans and AI robots is harmonious"; 1 = *completely disagree*, 7 = *completely agree*). We averaged responses to form an index ($\alpha = .75$), with higher scores reflecting perception of more harmonious Human–AI Robot relationship.

Results and Discussion

As intended, participants in the high social connectedness condition ($M = 6.09$, $SD = 0.87$) reported greater social connectedness than those in the control condition ($M = 3.88$, $SD = 1.09$), $F(1, 139) = 178.14$, $p < .001$, $\eta^2 = .56$, 90% CI [0.47, 0.63].[1] The manipulation was effective.

Participants in the high social connectedness condition ($M = 4.90$, $SD = 0.93$) perceived the quality of human–AI robot relationship to be higher than those in control condition ($M = 4.42$, $SD = 0.90$), $F(1, 139) = 9.66$, $p = .002$, $\eta^2 = .07$, 90% CI [0.01, 0.14]. Thus, social connectedness directly strengthened responses to innovative technology.

In two additional studies (Studies S1 and S2, Supplemental Material), we replicated this finding using a different manipulation of social connectedness (i.e., test feedback in Supplemental Study S1), an alternative operationalization of responses to AI technology (i.e., psychological closeness with AI robots in Supplemental Studies S1 and S2), and another cultural group (i.e., U.S. participants in Supplemental Study S2).

Study 1B

In experimental Study 1B, we examined the causal effect of skepticism about change on responses to innovative technology, both attitudinal (i.e., support for research on innovative technologies) and behavioral (i.e., behavioral support for innovative technology). Additionally, we extended the reach of our model by testing it with 5G, another exemplar of innovative technology (Rao & Prasad, 2018; Tang et al., 2021). Yet, 5G represents only incremental change over its 4G (fourth-generation wireless communication) predecessor and is relatively familiar to consumers. Assessing responses to these different innovative technologies allowed us to examine whether the effects of skepticism about change would be more pronounced for disruptive than incremental innovation.

Method

Participants

A power analysis indicated that an N of 158 would afford 80% power for detecting a medium-size effect ($r = -.22$) of skepticism about change on responses to innovative technology ($\alpha = .05$).[2] We recruited 200 Chinese students (142 women, 58 men; $M_{age} = 25.56$ years, $SD_{age} = 3.70$ years) at Beijing Normal University. We randomly assigned them to the high ($n = 100$) or low ($n = 100$) skepticism about change condition, remunerating each with 10 CNY (1.5 USD).

Procedure and Materials

Skepticism About Change Manipulation. We manipulated skepticism about change with a paradigm similar to Wildschut et al. (2006, Study 4). Participants completed an eight-item skepticism scale that we constructed for the purpose of this research. In the high skepticism condition, we phrased each item so as to elicit agreement (e.g., "I *sometimes* fear change, because of the uncertainty it brings"; 1 = *strongly disagree*, 7 = *strongly agree*), whereas, in the low skepticism condition, we phrased each item so as to elicit disagreement (e.g., "I *always* fear change, because of the uncertainty it brings"; 1 = *strongly disagree*, 7 = *strongly agree*). Next, participants received bogus feedback that their skepticism score was either in the 32nd percentile (low skepticism condition) or 68th percentile (high skepticism condition) among their peers. Afterward, participants took at least 2 min to write down why they were so high/low on skepticism about change. As intended, participants in the high skepticism about change condition ($M = 4.81$, $SD = 1.12$) reported greater agreement with the items than those in the low skepticism about change condition, $M = 3.99$, $SD = 1.39$, $F(1, 198) = 20.87$, $p < .001$, $\eta^2 = .10$, 90% CI [0.04, 0.16]. Last, as a manipulation check, participants responded to three items (i.e., "Right now, I am feeling quite skeptical about change," "Right now, I am having skeptical feelings about change," "I feel skeptical about change at the moment"; 1 = *strongly disagree*, 7 = *strongly agree*; $\alpha = .94$).

Attitudinal Support for Research on Innovative Technologies. We measured participants' support for research on AI/5G technology with two items each, and in counterbalanced order (e.g., "To what extent do you support research on [AI/5G] technology?"; 1 = *not at all*, 7 = *very much*). We averaged across the two items assessing support for research on AI, $r(198) = .55$, $p < .001$) and support for research on 5G technology ($r(198) = .43$, $p < .001$), with higher values indicating more support.

Behavioral Support for Innovative Technologies. We measured behavioral support for innovative technologies with a paradigm similar to Venus et al. (2019, Study 2). Participants read:

> The Science and Technology Club at our university is planning to launch an exhibition. The purpose of this activity is to let students have access to some exemplars of innovative technology (i.e., 5G, Tmall Genie, cyborgisation, and AI neural networks). The Club will soon invite professors to explain how these technologies do what they do. Now, the Club needs some letters to stir interest among students so that they participate in this activity. We would like to ask you to help the Club prepare one such letter, as you represent the population of students on our campus. On the next page, please write a draft letter. It can be as long as you want it to be.

[1] In the preregistration of Study 1A, we specified that we would compare the social connectedness and control conditions with independent samples t tests. We switched to reporting mathematically equivalent F tests to maintain consistency with analyses reported throughout the manuscript (for tests with 1 numerator degree of freedom, $F = t^2$).

[2] As preregistered, the effect-size estimate was based on correlations between skepticism about change and responses to innovative technology in Studies 2–3, which were completed prior to Study 1B. These correlations ranged from $r = -.10$ to $r = -.34$, and we used the midpoint of this range, $r = -.22$.

Next, participants expressed their support for innovative technology by drafting letters to encourage other students to attend the exhibition. Specifically, participants invested time and effort in describing what benefits or welfare they thought innovative technology might generate. In accordance with the prior research (Venus et al., 2019, Study 2), we treated both time (in seconds) spent writing this letter and number of characters used to write this letter as indices of behavioral support for innovative technology.[3]

Results and Discussion

As intended, participants in the high skepticism condition (M = 4.85, SD = 1.31) reported greater skepticism about change than those in the low skepticism condition (M = 3.25, SD = 1.45), $F(1, 198) = 66.81$, $p < .001$, $\eta^2 = .25$, 90% CI [0.17, 0.33]. The manipulation was successful.

We conducted a 2 (skepticism about change: high vs. low) × 2 (technology: 5G vs. AI) mixed analysis of variance (ANOVA) on attitudinal support for research on innovative technology.[4] The results revealed a significant main effect of skepticism about change, $F(1, 198) = 19.40$, $p < .001$, $\eta^2 = 0.09$, 90% CI [0.04, 0.16], with participants in the high skepticism condition (M = 5.13, SD = 0.92) reporting less support for research on innovative technology than those in the low skepticism condition (M = 5.65, SD = 0.75). The main effect of technology was also significant, $F(1, 198) = 16.79$, $p < .001$, $\eta^2 = 0.08$, 90% CI [0.03, 0.14], with participants reporting more support for research on AI (M = 5.53, SD = 1.02) than for research on 5G (M = 5.24, SD = 1.01). Furthermore, the two-way interaction was significant, $F(1, 198) = 7.65$, $p = .006$, $\eta^2 = 0.04$, 90% CI [0.01, 0.09]. We probed this interaction with tests of simple skepticism effects for each technology. Participants in the high skepticism condition (M = 5.08, SD = 1.01) reported less support for research on 5G than those in the low skepticism condition (M = 5.41, SD = 0.99), $F(1, 198) = 5.28$, $p = .023$, $\eta^2 = .03$, 90% CI [0.00, 0.07]. Participants in the high skepticism condition (M = 5.18, SD = 1.14) also reported less support for research on AI than those in the low skepticism condition (M = 5.90, SD = 0.73), $F(1, 198) = 28.30$, $p < .001$, $\eta^2 = .13$, 90% CI [0.06, 0.20]. Skepticism about change reduced attitudinal support for research on innovative technology, and this skepticism effect was significantly larger for AI (than 5G) technology. We offer an interpretation of this difference (and the related findings in Studies 2 and 3) in the General Discussion section.

Finally, we examined the effect of skepticism about change on behavioral support for innovative technology. As expected, participants in the high skepticism condition (M = 36.16, SD = 27.88) wrote fewer characters in their letter than those in the low skepticism condition (M = 58.52, SD = 64.78), $F(1, 198) = 10.05$, $p = .002$, $\eta^2 = .05$, 90% CI [0.01, 0.10]). Also as expected, participants in the high skepticism condition (M = 114.5, SD = 91.39) spent less time writing the letter than those in the low skepticism condition (M = 162.13, SD = 138.63), $F(1, 198) = 8.23$, $p = .005$, $\eta^2 = .04$, 90% CI [0.01, 0.09]).[5] Skepticism about change reduced behavioral support for innovative technology.

Study 2

In cross-sectional Study 2, we tested the dual-pathway model, namely, that two opposing mechanisms—social connectedness and skepticism about change—underlie the link between nostalgia and responses to innovative technology. We tested the model in regard to both AI and 5G technologies. Assessing responses to these different innovative technologies allowed us to examine the generality of our findings, and we did so by evaluating the tenability of equality constraints in a path model. If the paths are stronger for AI than for 5G, it is plausible that the hypothesized model is more suitable for future oriented technological products than for incremental technology.

Method

Participants

Aiming for an N of 250 (Schönbrodt & Perugini, 2013), we recruited 300 United Kingdom participants via Prolific compensating each with 1 GBP (1.39 USD). We excluded two participants: One did not complete the Southampton Nostalgia Scale, and another completed neither the Southampton Nostalgia Scale nor the social connectedness scale. The final sample comprised 298 participants (148 women, 147 men, three others; M_{age} = 37.90 years, SD_{age} = 13.84 years).

Procedure and Materials

Nostalgia. We assessed dispositional nostalgia with the seven-item version of the Southampton Nostalgia Scale (Sedikides et al., 2015; Wildschut et al., 2023; Wildschut & Sedikides, 2022). Participants first read a definition of nostalgia ("a sentimental longing for one's past"). Subsequently, they responded to four questions about the frequency (e.g., "How often do you experience nostalgia?"; 1 = *very rarely*, 7 = *very frequently*) and three questions about the personal importance (e.g., "How important is nostalgia for you?"; 1 = *not at all*, 7 = *very much*) of their nostalgic engagement. We averaged responses to form an index (α = .93), with higher scores reflecting greater dispositional nostalgia.

Social Connectedness. We assessed social connectedness with four items (e.g., I feel connected to loved ones; 1 = *strongly*

[3] Three participants returned their letter empty. All other participants listed benefits of innovative technologies (e.g., "Innovative technology is making our life better. Welcome!"). No participants listed disadvantages of innovative technology. The number of characters is a count variable; however, one-sample Kolmogorov–Smirnov tests revealed that this variable did not follow a Poisson distribution, $p < .001$.

[4] We preregistered one-way ANOVAs on attitudinal and behavioral support for innovative technologies. However, to increase granularity, we report the results of a 2 (skepticism about change: high, low) × 2 (technology: AI, 5G) mixed ANOVA on attitudinal support for innovative technologies. The main effect of skepticism in this 2 × 2 mixed ANOVA is mathematically equivalent to the main effect of skepticism in the preregistered one-way ANOVA, averaging across support for AI and 5G (Judd & Kenny, 2010). We report tests of simple skepticism effects on attitudinal support for each technology when probing the Skepticism × Technology interaction. Thus, we report all preregistered analyses.

[5] Number of characters and writing time were positively skewed (skewness = 4.89 for number of characters; skewness = 1.93 for writing time). In an ancillary analysis, we normalized these variables by taking the natural logarithm. Consistent with analysis of the untransformed scores, participants in the high skepticism condition (M = 3.26, SD = 0.98) wrote fewer characters in their letter than those in the low skepticism condition (M = 3.74, SD = 0.82), $F(1, 198) = 13.88$, $p < .001$, $\eta^2 = .07$, 90% CI [0.02, 0.13]. Further, participants in the high skepticism condition (M = 4.40, SD = 0.94) spent less time writing the letter than those in the low skepticism condition (M = 4.80, SD = 0.77), $F(1, 198) = 10.77$, $p = .001$, $\eta^2 = .05$, 90% CI [0.01, 0.11]).

Table 1
Descriptive Statistics and Zero-Order Correlations Among Variables in Study 2

Variable	*M* (*SD*)	1	2	3	4	5
1. Nostalgia	4.61 (1.25)	—	.17**	.27***	−.08	−.01
2. Social connectedness	4.99 (1.07)		—	−.09	.21***	.19**
3. Skepticism about change	4.27 (1.01)			—	−.28***	−.18**
4. Support for research on AI	4.07 (1.47)				—	.77***
5. Support for research on 5G	4.04 (1.50)					—

Note. AI = artificial intelligence; 5G = fifth-generation wireless communication.
** $p < .01$. *** $p < .001$.

disagree, 7 = *strongly agree*; Hepper et al., 2012; Wildschut et al., 2006), preceded by the stem "In general. …" We averaged responses to form an index (α = .82), with higher scores reflecting greater social connectedness.

Skepticism About Change. We assessed skepticism about change with four items that we generated for the purpose of this study (e.g., "I am not sure change is good"; 1 = *strongly disagree*, 7 = *strongly agree*). We averaged responses to form an index (α = .79), with higher scores reflecting greater skepticism about change.

Support for Research on Innovative Technologies. We measured both support for research on AI technology and support for research on 5G technology. We measured each construct with the three items (e.g., "To what extent do you support research on [AI/5G] technology?"; 1 = *not at all*, 7 = *very much*). We averaged across the three items to create composites from AI technology (α = .91) and 5G technology (α = .90), with higher values indicating more support.

Results and Discussion

We report descriptive statistics and intercorrelations in Table 1. Nostalgia was positively correlated with social connectedness and skepticism about change. Social connectedness was positively correlated with support for research on AI and 5G technologies but skepticism about change was negatively correlated with these two outcomes.

We tested the entire hypothesized model with Mplus 7.0 to accommodate support for research on AI technology and 5G technology as parallel outcome variables.[6] We specified a saturated model (M_1) with nostalgia as the independent variable, social connectedness, and skepticism about change as parallel mediators, and support for research on AI technology and 5G technology as outcome variables (Figure 2). The Mplus default is to estimate residual covariances for outcome variables. Without these residual covariances, the model would likely be misspecified, because these residuals are typically correlated (as they were in the present study). We also allowed a residual covariance between the parallel mediators, social connectedness, and skepticism.

Nostalgia positively predicted social connectedness (b = 0.15, 95% CI [0.05, 0.24], SE = 0.05, z = 2.99, p = .003, b^* = .17), which in turn positively predicted support for research on AI technology (b = 0.27, 95% CI [0.12, 0.42], SE = 0.08, z = 3.48, p = .001, b^* = .20) and support for research on 5G technology (b = 0.24, 95% CI [0.08, 0.40], SE = 0.08, z = 3.00, p = .003, b^* = .17). Tests of indirect effects revealed that nostalgia promoted support for research on AI technology via increased social connectedness (ab = .04, 95% CI [0.01, 0.09]), and strengthened support for research on 5G technology via increased social connectedness (ab = .04, 95% CI [0.01, 0.08].

Also, nostalgia positively predicted skepticism about change (b = 0.22, 95% CI [0.13, 0.31], SE = 0.05, z = 4.85, p < .001, b^* = .27), which in turn negatively predicted support for research on AI technology (b = –0.36, 95% CI [–0.52, –0.19], SE = 0.08, z = –4.31, p < .001, b^* = –.25) and support for research on 5G technology (b = –0.25, 95% CI [–0.42, –0.07], SE = 0.09, z = –2.81, p = .005, b^* = –.17). Tests of indirect effects showed that nostalgia reduced support for research on AI technology via increased skepticism about change (ab = –.08, 95% CI [–0.14, –0.04]) and reduced support for research on 5G technology via increased skepticism about change (ab = –.05, 95% CI [–0.11, –0.02]). When controlling for the directionally opposite indirect effects via social connectedness and skepticism about change, the direct effects of nostalgia on support for research on AI technology (b = –0.05, 95% CI [–0.19, 0.08], SE = 0.07, z = –0.78, p = .435, b^* = –.05) and support for research on 5G technology (b = 0.00, 95% CI [–0.14, 0.14], SE = 0.07, z = 0.03, p = .976, b^* = .00) were not statistically significant.

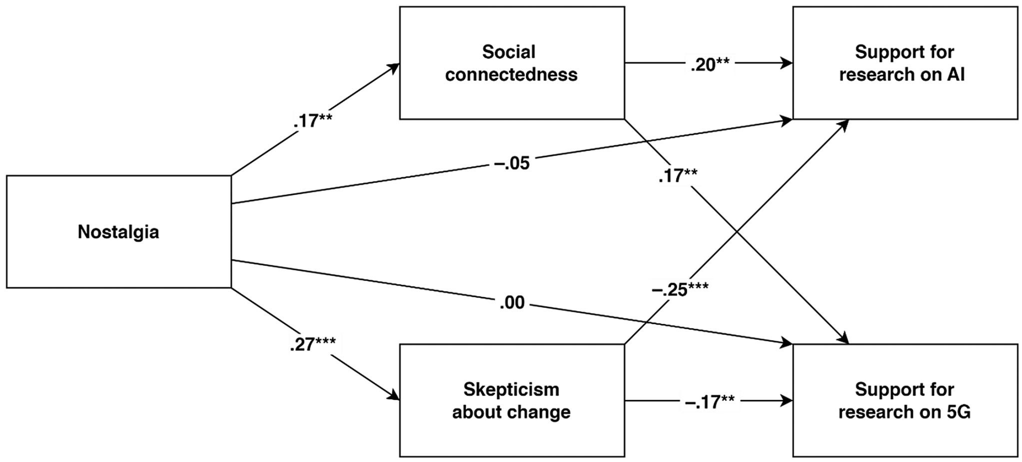
In a next step, we evaluated the tenability of three equality constraints.[7] We report model fit statistics in Table 2. First, we obtained M_2 (from M_1) by imposing an equality constraint on the paths from social connectedness to the two outcomes. Imposing this equality constraint did not significantly reduce model fit (M_2 vs. M_1: $\Delta\chi^2$ = 0.21, Δdf = 1, p = .651), indicating that social connectedness predicted support for research on AI and 5G technologies to a similar degree. The pooled estimate of the path from social connectedness to support for research on AI/5G technology was significant, b = 0.26, 95% CI [0.11, 0.40], SE = 0.07, z = 3.50, p < .001, b^* = .19. Second, we obtained M_3 by imposing an equality constraint on the paths from skepticism about change to the two outcomes. There was a trend for skepticism about change to more strongly predict support for research on AI technology than support for research on 5G technology (Figure 2). However, imposing the equality constraint did not significantly reduce model fit (M_3 vs. M_1: $\Delta\chi^2$ = 3.49, Δdf = 1, p = .062); that is, the paths did not differ significantly. The pooled path estimate was significant, b = –0.31,

[6] For Study 2 (and Studies 3–4), we preregistered that we would use either Mplus or Hayes (2022) PROCESS macro to conduct the mediation analyses. We selected Mplus because it enabled us to specify support for research on AI technology and 5G technology as parallel outcome variables and, by so doing, evaluate the tenability of equality constraints.

[7] We did not preregister tests of equality constraints in Study 2 (nor in Studies 3–4). These analyses are ancillary to the preregistered mediation analyses, which we report.

Figure 2

Associations Among Nostalgia, Social Connectedness, Skepticism About Change, and Support for Research on AI and 5G Technologies in Study 2



Note. Coefficients are fully standardized. To enhance figure clarity, we omitted the correlated residuals between the mediators (covariance = –0.15, 95% CI [–0.26, –0.03], SE = 0.06, p = .015) and the outcome variables (covariance = 1.51, 95% CI [1.23, 1.80], SE = 0.15, p < .001). AI = artificial intelligence; CI = confidence interval; SE = standard error; 5G = fifth-generation wireless communication.
** $p < .01$. *** $p < .001$.

95% CI [–0.47, –0.16], $SE = 0.08$, $z = -3.91$, $p < .001$, $b^* = -.21$. Third, we obtained M_4 by imposing an equality constraint on the residual direct effects from nostalgia to the two outcomes. This equality constraint was also tenable (M_4 vs. M_1: $\Delta\chi^2 = 1.25$, $\Delta df = 1$, $p = .263$). The pooled direct effect was not significant, $b = -0.03$, 95% CI [–0.16, 0.10], $SE = 0.07$, $z = -0.47$, $p = .635$, $b^* = -.03$. Taken together, tests of equality constraints revealed a similar results pattern for responses to AI technology as for responses to 5G technology, supporting the generality of our findings.

Finally, we tested the tenability of an equality constraint on the absolute magnitude of the respective indirect effects via social connectedness and skepticism about change. For both support for research on AI technology (Wald $\chi^2 = 1.53$, $df = 1$, $p = .216$) and support for research on 5G technology (Wald $\chi^2 = 0.39$, $df = 1$, $p = .534$), the equality constraint was tenable. In terms of absolute magnitude, the indirect effects via social connectedness did not differ significantly from the indirect effects via skepticism about change.

Table 2

Model Comparisons in Study 2

Model	χ^2	df	p	RMSEA	CFI	TLI	SRMR
M_1	0	0	0	0	1	1	0
M_2	0.21	1	.651	0	1	1	.003
M_3	3.49	1	.062	.091	.993	.925	.014
M_4	1.25	1	.263	.029	.999	.992	.007

Note. M_1 = the saturated model; M_2 = the model imposing equality constraint on the paths from social connectedness to the two outcomes; M_3 = the model imposing equality constraint on the paths from skepticism about change to the two outcomes; M_4 = the model imposing equality constraint on the residual direct effect from nostalgia to the two outcomes; RMSEA = root-mean-square error of approximation; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual.

Study 3

In experimental Study 3, we took steps toward testing the core of our model experimentally, thus extending the correlational findings of Study 2. We operationalized responses to innovative technology in terms of both attitudes (i.e., support for research on AI technology and 5G technology) and behavior (i.e., voluntary participation in a research program on innovative technologies).

Method

Participants

We used a web-based Monte Carlo power analysis app (Schoemann et al., 2017)[8] to estimate the sample size required to observe an indirect effect of manipulated nostalgia on attitudes (and behavior) toward technological innovation via social connectedness and an indirect effect via skepticism about change. Based on the results of a pilot study, we could detect two indirect effects with 274 participants at 80% power and an α level of .05 (see parameters used in the power analysis in Supplemental Material). We recruited 300 Chinese participants via Credamo. Nine of them failed an attention check (i.e., completing two easy arithmetic calculations). The final

[8] Due to an oversight, the preregistrations of Studies 3–4 stated that we used the web-based MedPower app developed by Kenny (2017). Instead, we used the web-based Monte Carlo power analysis app developed by Schoemann et al. (2017). The latter app allows researchers to specify a model with two parallel mediators, whereas the former does not.

sample included 291 participants (172 women, 119 men; M_{age} = 29.34 years, SD_{age} = 6.50 years). We randomly assigned them to the nostalgia (n = 147) or control (n = 144) condition, compensating each with 10 CNY (1.5 USD).

Procedure and Materials

Nostalgia Manipulation. We induced nostalgia using the Event Reflection Task (Sedikides et al., 2015). Participants recalled either a nostalgic event (nostalgia condition) or an ordinary event (control condition) from their past, reflected on it, summarized it in a few key words, and wrote a brief description of it. Next, they completed a three-item manipulation check (Wildschut et al., 2006; e.g., "Right now, I am feeling quite nostalgic"; 1 = *strongly disagree*, 7 = *strongly agree*; α = .95).

Social Connectedness. We measured this variable with the four items that we used in Study 2 (e.g., "protected," "connected to loved ones"; 1 = *strongly disagree*, 7 = *strongly agree*; α = .82) preceded by the stem "Thinking about this event makes me feel. …"

Skepticism About Change. We measured this variable with the same four items as in Study 2 (i.e., "I am not sure change is good"; 1 = *strongly disagree*, 7 = *strongly agree*; α = .83). We instructed participants to respond to the items based on how they felt at the moment.

Support for Research on Innovative Technologies. Aiming for brevity, we measured support for research on AI and 5G technologies with two items each that is, "To what extent do you support research on [AI/5G] technology?" and "To what extent do you support the use of taxpayer money for research on [AI/5G] technology?"; 1 = *not at all*, 7 = *very much*. We averaged across the two items to create composites corresponding to support for research on AI technology, $r(289)$ = .63, p < .001, and 5G technology, $r(289)$ = .51, p < .001.

Participation in Research on Innovative Technologies. To measure participation in research on AI/5G technology, we asked participants to read the following instructions:

> We are collaborating with Baidu[9] on a research program regarding products powered by [AI/5G] technology. Baidu is planning to recruit volunteers to try out some [AI/5G] products and ask them to report their experiences. Please indicate whether you would like to participate in this research program as a volunteer. If you decide that you do, we will ask you to write down your name, email address, and mobile phone number. Baidu will then contact you to arrange your involvement in this research.

Subsequently, participants responded with a "No" or "Yes" (coded 0, 1, respectively) to a question of whether they would volunteer for this research. If their answer was positive, they next listed their contact information. As a reminder, we instructed them that they would receive participation information via the contact they had listed, and that listing contact information was the first step in program participation and followed by debriefing. Participants were informed that the study was unrelated to Baidu, and the mentioned research program was fictitious.

Results and Discussion

As intended, participants in the nostalgia condition (M = 5.76, SD = 0.79) felt more nostalgic than controls (M = 3.05, SD = 1.06), $F(1, 289)$ = 611.64, p < .001, η^2 = .68, 90% CI [0.62, 0.70]. The nostalgia manipulation was successful.

Nostalgic participants (M = 5.42, SD = 0.79) reported higher social connectedness than controls (M = 4.97, SD = 1.09), $F(1, 289)$ = 16.23, p < .001, η^2 = .05, 90% CI [0.02, 0.10]. Additionally, nostalgic participants (M = 4.47, SD = 1.15) reported greater skepticism about change than controls (M = 3.98, SD = 1.22), $F(1, 289)$ = 12.73, p < .001, η^2 = .04, 90% CI [0.01, 0.09]. However, nostalgic participants did not differ from controls in support for research on AI technology, M = 5.34, SD = 1.03 vs. M = 5.37, SD = 1.13; $F(1, 289)$ = 0.05, p = .825, or 5G technology, M = 5.78, SD = 0.83 vs. M = 5.78, SD = 1.03; $F(1, 289)$ = 0.003, p = .958. Similarly, nostalgic participants did not volunteer to a greater extent than controls to participate in research on AI technology, 31% (44/144) versus 28% (41/147); $\chi^2(1)$ = 0.25, p = .699, or 5G technology, 34% (49/144) versus 27% (40/147); $\chi^2(1)$ = 1.59, p = .252.

Mediation Analyses

We report descriptive statistics and intercorrelations in Table 3 and model fit statistics in Tables 4–5.

We followed the same data-analytic approach as in Study 2, using Mplus 7.0. We conducted two mediation analyses, one focused on attitudes and one on behavior toward innovative technology. In both analyses, the nostalgia manipulation (1 = nostalgia condition, 0 = control condition) was the independent variable, and social connectedness and skepticism about change were parallel mediators. In the first analysis, support for research on AI and 5G technologies were the outcome variables (Figure 3). In the second analysis, participation in research on AI and 5G technologies were the outcome variables (Figure 4). We designated participation in research on AI and 5G technologies as dichotomous outcome variables via the CATEGORICAL statement in Mplus.

Support for Research on AI and 5G Technologies. We specified a saturated model (Table 4, M_1). Nostalgia positively predicted social connectedness (b = 0.45, 95% CI [0.23, 0.67], SE = 0.11, p < .001, z = 4.04, b^* = .23), which in turn positively predicted support for research on AI technology (b = 0.19, 95% CI [0.07, 0.31], SE = 0.06, z = 3.02, p = .003, b^* = .17) and support for research on 5G technology (b = 0.14, 95% CI [0.03, 0.25], SE = 0.06, z = 2.52, p = .012, b^* = .15). Nostalgia promoted support for research on AI technology via increased social connectedness (ab = .08, 95% CI [0.03. 0.16]), and strengthened support for research on 5G technology via increased social connectedness (ab = .06, 95% CI [0.01, 0.13]).

At the same time, nostalgia positively predicted skepticism about change (b = 0.50, 95% CI [0.23, 0.77], SE = 0.14, z = 3.59, p < .001, b^* = .21), which in turn negatively predicted support for research on AI technology (b = –0.30, 95% CI [–0.40, –0.20], SE = 0.05, z = –6.03, p < .001, b^* = –.34) and support for research on 5G technology (b = –0.16, 95% CI [–0.25, –0.07], SE = 0.05, z = –3.49, p < .001, b^* = –.20). Nostalgia reduced support for research on AI technology via increased skepticism about change (ab = –.15, 95% CI [–0.26, –0.07]) and reduced support for research on 5G technology via increased skepticism about change (ab = –.08, 95% CI [–0.16, –0.03]). When controlling for the directionally opposite indirect effects via social connectedness and skepticism about

[9] Baidu is a well-known Chinese technology company.

Table 3
Descriptive Statistics and Zero-Order Correlations Among Variables in Study 3

Variable	M (SD)	1	2	3	4	5	6	7
1. Nostalgia manipulation	0.51 (0.50)	—	.23***	.21***	−.01	−.003	.03	.07
2. Social connectedness	5.20 (0.97)		—	−.03	.18**	.15**	.20***	.22***
3. Skepticism about change	4.23 (1.21)			—	−.34***	−.21***	−.14*	−.10†
4. Support for research on AI	5.36 (1.08)				—	.70***	.34***	.27***
5. Support for research on 5G	5.78 (0.94)					—	.22***	.33***
6. Participation in AI research	0.71 (0.45)						—	.64***
7. Participation in 5G research	0.69 (0.46)							—

Note. Nostalgia manipulation: nostalgia condition = 1, control condition = 0. Participation in AI/5G research: yes = 1, no = 0. The standard deviation for dichotomous variables equals the square root of p^*q, where p and q represent the probabilities associated with the binary values 1, 0. Correlations among dichotomous variables (variables 1, 6, and 7) are phi coefficients. Correlations among continuous variables (variables 2–5) are Pearson correlations. Correlations of continuous variables with dichotomous variables are point-biserial correlations. Phi, point-biserial, and Pearson correlations are mathematically equivalent. AI = artificial intelligence; 5G = fifth-generation wireless communication.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

change, the direct effects of nostalgia on support for research on AI technology ($b = 0.04$, 95 CI [–0.20, 0.28], $SE = 0.12$, $z = 0.30$, $p = .764$, $b^* = .02$) and support for research on 5G technology ($b = 0.01$, 95 CI [–0.21, 0.23], $SE = 0.11$, $z = 0.08$, $p = .937$, $b^* = .01$) were not statistically significant.

Next, we evaluated three equality constraints (Table 4). First, we obtained M_2 by imposing an equality constraint on the paths from social connectedness to the two outcomes. Imposing this equality constraint did not significantly reduce model fit (M_2 vs. M_1: $\Delta\chi^2 = 0.91$, $\Delta df = 1$, $p = .340$), indicating that social connectedness predicted support for research on AI and 5G technologies to a similar degree. The pooled estimate of the path from social connectedness to support for research on AI/5G technology was significant, $b = 0.16$, 95% CI [0.05, 0.26], $SE = 0.05$, $z = 2.93$, $p = .003$, $b^* = .15$. We then obtained M_3 by imposing an equality constraint on the paths from skepticism about change to the two outcomes. This equality constraint did reduce model fit and was therefore untenable (M_3 vs. M_1: $\Delta\chi^2 = 13.76$, $\Delta df = 1$, $p < .001$). Both negative associations were statistically significant, but skepticism about change more strongly predicted support for research on AI technology than support for research on 5G technology (Figure 3). Finally, we obtained M_4 by imposing an equality constraint on the residual direct effects from nostalgia to the two outcomes. This equality constraint was tenable (M_4 vs. M_1: $\Delta\chi^2 = 0.89$, $\Delta df = 1$, $p = .766$). The pooled direct effect was not significant, $b = 0.02$, 95% CI [–0.19, 0.23], $SE = 0.11$, $z = 0.17$, $p = .862$, $b^* = .01$.

Table 4
Model Comparisons in Study 3: Support for Research on AI and 5G Technologies

Model No.	χ^2	df	p	RMSEA	CFI	TLI	SRMR
M_1	0	0	0	0	1	1	0
M_2	0.91	1	.340	0	1	1	.009
M_3	13.67	1	<.001	.209	.952	.525	.046
M_4	0.89	1	.766	0	1	1	.002

Note. M_1 = the saturated model; M_2 = the model imposing equality constraint on the paths from social connectedness to the two outcomes; M_3 = the model imposing equality constraint on the paths from skepticism about change to the two outcomes; M_4 = the model imposing equality constraint on the residual direct effect from nostalgia to the two outcomes; AI = artificial intelligence; 5G = fifth-generation wireless communication; RMSEA = root-mean-square error of approximation; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual.

We also tested the tenability of an equality constraint on the absolute magnitude of the respective indirect effects via social connectedness and skepticism about change. For both support for research on AI technology (Wald $\chi^2 = 1.10$, $df = 1$, $p = .294$) and support for research on 5G technology (Wald $\chi^2 = 0.10$, $df = 1$, $p = .747$), the equality constraint was tenable. In terms of absolute magnitude, the indirect effects via social connectedness did not differ significantly from the indirect effects via skepticism about change.

Participation in Research on AI and 5G Technologies. We estimated a saturated model (Table 5, M_1). Nostalgia positively predicted social connectedness ($b = 0.45$, 95% CI [0.22, 0.68], $SE = 0.12$, $z = 3.85$, $p < .001$, $b^* = .23$), which in turn positively predicted participation in research on AI technology ($b = 0.25$, 95% CI [0.11, 0.39], $SE = 0.07$, $z = 3.41$, $p = .001$, $b^* = .24$) and participation in research on 5G technology ($b = 0.25$, 95% CI [0.12, 0.39], $SE = 0.07$, $z = 3.68$, $p < .001$, $b^* = .25$). Nostalgia promoted participation in research on AI technology via increased social connectedness ($ab = 0.11$, 95% CI [0.03, 0.22]), and strengthened participation in research on 5G technology via increased social connectedness ($ab = 0.11$, 95% CI [0.03, 0.22].

Also, nostalgia positively predicted skepticism about change ($b = 0.50$, 95% CI [0.23, 0.77], $SE = 0.14$, $z = 3.59$, $p < .001$, $b^* = .21$), which in turn negatively predicted participation in research on AI technology ($b = –0.15$, 95% CI [–0.26, –0.03], $SE = 0.06$, $z = –2.54$, $p = .011$, $b^* = –.18$) and participation in research on 5G technology ($b = –0.11$, 95% CI [–0.22, –0.001], $SE = 0.06$, $z = –1.97$, $p = .049$, $b^* = –.13$). Nostalgia reduced participation in research on AI technology via increased skepticism about change ($ab = –0.07$, 95% CI [–0.19, –0.03]), and reduced participation in research on 5G technology via increased skepticism about change ($ab = –0.06$, 95% CI [–0.16, –0.01]). When controlling for the opposing indirect effects via social connectedness and skepticism about change, the direct effects of nostalgia on participation in research on AI technology ($b = 0.04$, 95% CI [–0.27, 0.35], $SE = 0.16$, $z = 0.25$, $p = .803$, $b^* = .02$) and participation in research on 5G technology ($b = 0.14$, 95% CI [–0.17, 0.45], $SE = 0.16$, $z = 0.86$, $p = .390$, $b^* = .07$) were not statistically significant.

Table 5
Model Comparisons in Study 3: Participation in Research on AI and 5G Technologies

Model No.	χ^2	*df*	*p*	RMSEA	CFI	TLI	SRMR
M_1	0	0	0	0	1	1	0
M_2	0.01	1	.916	0	1	1	.001
M_3	0.64	1	.425	0	1	1	.007
M_4	0.47	1	.491	0	1	1	.008

Note. M_1 = the saturated model; M_2 = the model imposing equality constraint on the paths from social connectedness to the two outcomes; M_3 = the model imposing equality constraint on the paths from skepticism about change to the two outcomes; M_4 = the model imposing equality constraint on the residual direct effect from nostalgia to the two outcomes; AI = artificial intelligence; 5G = fifth-generation wireless communication; RMSEA = root-mean-square error of approximation; CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardized root-mean-square residual.

In a final step, we evaluated three equality constraints (Table 5). We first imposed an equality constraint on the paths from social connectedness to the two outcomes and obtained M_2. Imposing this equality constraint did not reduce model fit (M_2 vs. M_1: $\Delta\chi^2 = 0.01$, $\Delta df = 1$, $p = .916$), suggesting that social connectedness predicted both outcomes with similar strength. The pooled path estimate was significant, $b = 0.25$, 95% CI [0.12, 0.38], $SE = 0.07$, $z = 3.84$, $p < .001$, $b^* = .24$. We then imposed an equality constraint on the paths from skepticism about change to the two outcomes and obtained M_3. Imposing this equality constraint did not reduce model fit (M_3 vs. M_1: $\Delta\chi^2 = 0.64$, $\Delta df = 1$, $p = .313$), indicating that skepticism about change also predicted both outcomes with similar strength. The pooled path estimate was significant, $b = -0.13$, 95% CI [–0.23, –0.03], $SE = 0.05$, $z = -2.49$, $p = .013$, $b^* = -.16$. The third equality constraint, on the direct effects from nostalgia to the outcomes, did not reduce model fit either (M_4 vs. M_1: $\Delta\chi^2 = 0.47$, $\Delta df = 1$, $p = .491$), indicating that it too was tenable. The pooled direct effect was not significant, $b = 0.09$, 95% CI [–0.19, 0.37], $SE = 0.14$, $z = 0.61$, $p = .540$, $b^* = .04$.

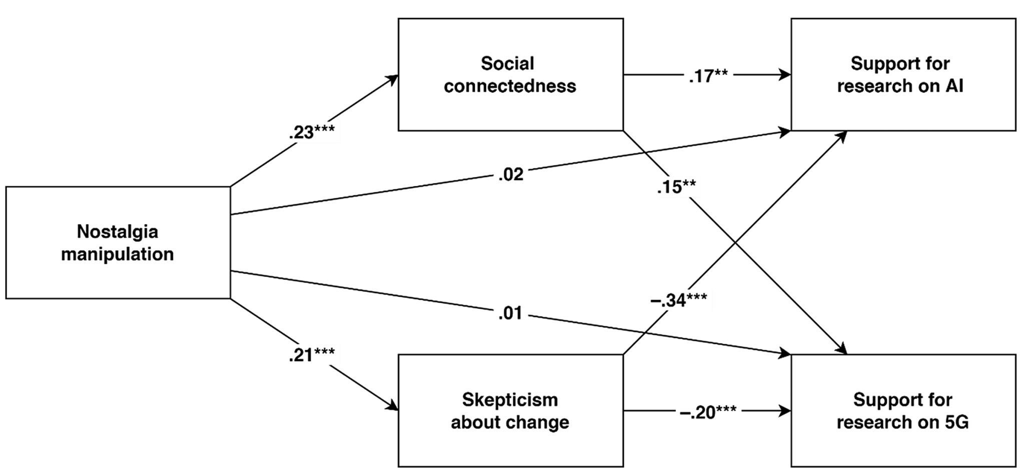
Finally, we tested the tenability of an equality constraint on the absolute magnitude of the respective indirect effects via social connectedness and skepticism about change. For both participation in AI research (Wald $\chi^2 = 0.38$, $df = 1$, $p = .538$) and participation in 5G research (Wald $\chi^2 = 1.02$, $df = 1$, $p = .312$), the equality constraint was tenable. In terms of absolute magnitude, the indirect effects via social connectedness did not differ significantly from the indirect effects via skepticism about change.

By manipulating nostalgia, Study 3 produced results consistent with those of Study 2 in support of the core proposition of our model: nostalgia influences responses to innovative technology via the opposing mechanisms of social connectedness and skepticism about change. As in Study 2, and corroborating the generality of our findings, tests of equality constraints revealed a highly similar results pattern for both AI and 5G technologies, with one exception. Although skepticism about change was significantly negatively associated with both support for research on AI technology and support for research on 5G technology, this association was stronger when the target was AI technology (a similar difference was significant in Study 1B and trending in Study 2). We offer a tentative interpretation in the General Discussion section.

Study 4

We had two objectives in experimental Study 4. To begin, in Studies 2 and 3, although we obtained results consistent with the

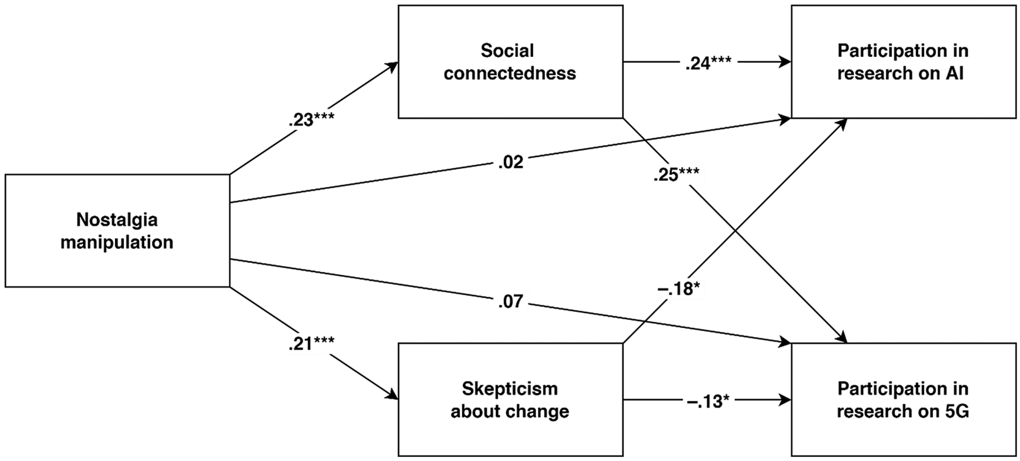
Figure 3
Effects of Nostalgia on Social Connectedness, Skepticism About Change, and Support for Research on AI and 5G in Study 3



Note. Nostalgia manipulation was coded: nostalgia condition = 1, control condition = 0. Coefficients are fully standardized. To enhance figure clarity, we omitted the correlated residuals between the two mediators (covariance = –0.09, 95% CI [–0.22, 0.04], $SE = 0.07$, $p = .159$) and the two outcome variables (covariance = 0.61, 95% CI [0.49, 0.74], $SE = 0.05$, $p < .001$). AI = artificial intelligence; CI = confidence interval; SE = standard error; 5G = fifth-generation wireless communication.
** $p < .01$. *** $p < .001$.

Figure 4

Effects of Nostalgia on Social Connectedness, Skepticism About Change, and Participation in Research on AI and 5G in Study 3



Note. Nostalgia manipulation was coded: nostalgia condition = 1, control condition = 0. Coefficients are fully standardized. To enhance figure clarity, we omitted the correlated residuals between the two mediators (covariance = −0.09, 95% CI [−0.20, 0.02], $SE = 0.06$, $p = .103$) and the two outcomes (covariance = 0.77, 95% CI [0.68, 0.86], $SE = 0.05$, $p < .001$). AI = artificial intelligence; *SE* = standard error; 5G = fifth-generation wireless communication.
* $p < .05$. *** $p < .001$.

hypothesized model, we assessed responses to general innovative technology rather than specific products. Here, we assessed responses to a specific AI product, companion robots, operationalized both attitudinally (i.e., support for research on companion robots) and behaviorally (i.e., adoption of companion robots). There is another reason, besides generality, that we opted for companion robots. In Studies 2 and 3, the opposing pathways via, respectively, social connectedness and skepticism about change, did not differ significantly in strength. It is possible, however, that the results of Studies 2 and 3 were due to the AI products being orthogonal to sociality. Does the balance shift in favor of the social connectedness pathway (relative to the skepticism pathway) when AI is imbued with sociality, as companion robots are? Indeed, such robots are designed to appear human-like and communicate as humans do; as a result, they are anthropomorphized. Although anthropomorphism has generally been linked not only to approach (Waytz et al., 2014; Yogeeswaran et al., 2016) but also to avoidance (Gray & Wegner, 2012; Złotowski et al., 2017) of innovative technology, robot anthropomorphism in particular elicits trust and acceptance (see Roesler et al., 2021, for a meta-analysis).

Additionally, in Study 3, we induced nostalgia with the Event Reflection Task (Sedikides et al., 2015; Wildschut & Sedikides, in press). This technique has been criticized for inviting participants to recall and narrate their most nostalgic experience ("try to think of a past event that makes you feel most nostalgic"; Newman et al., 2020). However, recent research has replicated prior findings by using a version of the task in which participants brought to mind and described a typical nostalgic event (Zhou et al., 2022) or, simply, a nostalgic event (Kelley et al., 2022) from their lives (rather than their most nostalgic experience). Nevertheless, to check the robustness and generalizability of the results, we manipulated nostalgia differently. We set two criteria for this manipulation. First, it should not include the word "nostalgia." This criterion ruled out demand characteristics, including the possibility that the results were due to participants recalling their most nostalgic experience. Second, the manipulation should not contain explicit mention of sociality. This criterion ruled out a possible confound, according to which the effects of nostalgia on social connectedness were due to participants being cued or reminded of the inherent sociality of the emotion; after all, in the version of the Event Reflection Task used in Study 3, nostalgia was defined as "… feeling sentimental about a fond and valued memory from one's personal past (e.g., childhood, close relationship, momentous events)."

Informed by these two criteria, our nostalgia manipulation comprised two successive but related tasks. One task was pictorial. Nostalgia has been induced with briefly presented pictures before (Oba et al., 2016; Yang et al., 2021), and we built on this paradigm. The other task capitalized on the prototypical structure of the construct "nostalgia," namely, that it encompasses both central and peripheral features (Hepper et al., 2012, 2014). The nostalgia prototype induction has been used previously (Hepper et al., 2012; R. N. Turner et al., 2018, 2022), and we modified it slightly to fit our second criterion.

Method

Participants

We implemented the web-based Monte Carlo power analysis app (Schoemann et al., 2017) to estimate the sample size required to observe an indirect effect of manipulated nostalgia on attitudes (and behavior) toward technological innovation via social connectedness and an indirect effect via skepticism about change. Based on the results of Study 3, we could detect two indirect effects with 264 participants at 80% power and an α level of .05 (see the parameters used in the power analysis in Supplemental Material). We recruited 300 Chinese participants (232 women, 68 men; $M_{\text{age}} = 20.21$ years, $SD_{\text{age}} = 2.43$ years) at Beijing Normal University. We randomly assigned them to the nostalgia (n = 150) or control (n = 150) condition, compensating each with 20 CNY (3 USD).

Procedure and Materials

Nostalgia Manipulation. In the first task (pictorial induction), we presented participants in the nostalgia condition with 20 pictures of nostalgic objects (e.g., marbles, Tetris game) and those in the control condition with 20 pictures of neutral objects (e.g., window, toothbrush).[10] We presented the pictures in a different random order for each participant, and for 5 s each. To ascertain general object familiarity and attentiveness, we asked participants whether they were familiar with each object (coded: 1 = familiar, 0 = unfamiliar). Participants in the nostalgia condition indicated high levels of familiarity (M = 17.79, SD = 1.50) and so did those in the control condition (M = 18.13, SD = 2.12), $F(1, 298) = 2.67$, p = .103, η^2 = .01, 90% CI [0.00, 0.03].[11]

In the second, successive task (nostalgia prototype induction), we presented participants in the nostalgia condition with 12 central nostalgia features (i.e., keepsakes, familiar smells) and those in the control condition with 12 peripheral nostalgia features (i.e., day-dreaming, regret), which “might describe or characterize experiences and memories that we have in our lives.” Subsequently, we instructed participants to bring to mind an event that was relevant to one of the pictures presented in the first task and was characterized by at least five features presented in the second task. Participants spent 5 min reliving the event and then another 5 min writing about the event and their feelings as they remembered it. Last, they completed a three-item manipulation check (α = .93), as in Study 3.

Social Connectedness. We measured this variable with the four items that we used in Study 3 (e.g., “connected to loved ones”; 1 = *strongly disagree*, 7 = *strongly agree*; α = .90).

Skepticism About Change. We measured this variable with the same four items as in Study 3 (i.e., “I am not sure change is good”; 1 = *strongly disagree*, 7 = *strongly agree*; α = .74).

Support for Research on Companion Robots. We measured this variable with three items (e.g., “To what extent do you support research on companion robots?”; 1 = *not at all*, 7 = *very much*). We averaged responses to create an index of support for research on companion robots (α = .88), with higher values indicating more support.

Adoption of Companion Robots. We presented participants with six contexts wherein either companion robots or real pets could be used (O’Hara, 2019): (1) playing with a child, (2) living with residents with dementia in a nursing home, (3) calming delirious patients in a hospital, (4) living with older people at a retirement center, (5) working as play partners for children with autism, and (6) living with socially isolated young adults. Participants indicated which of the two (companion robots or real pets) they would like to use in each context. We recorded their choices to use real pets (coded as 0) or companion robots (coded as 1). The total number of contexts in which participants adopted companion robots constituted the relevant index (range = 0–6).

Results and Discussion

As intended, participants in the nostalgia condition (M = 5.88, SD = 1.06) felt more nostalgic than controls (M = 3.43, SD = 1.81), $F(1, 298) = 205.03$, p < .001, η^2 = .41, 90% CI [0.34, 0.47]. The nostalgia manipulation was successful.

Nostalgic participants (M = 5.04, SD = 1.39) reported higher social connectedness than controls (M = 3.35, SD = 1.79), $F(1, 298)$ = 83.58, p < .001, η^2 = .22, 90% CI [0.15, 0.28]. Additionally, nostalgic participants (M = 4.15, SD = 1.32) reported greater skepticism about change than controls (M = 3.58, SD = 1.17), $F(1, 298) = 15.90$, p < .001, η^2 = .05, 90% CI [0.02, 0.10]. Furthermore, nostalgic participants (M = 4.62, SD = 1.20) reported greater support for research on companion robots than controls—a positive total effect (M = 4.21, SD = 1.20), $F(1, 298) = 8.67$, p = .003, η^2 = .03, 90% CI [0.01, 0.06]. Nostalgic (M = 2.21, SD = 1.41) and control (M = 2.11, SD = 1.40) participants did not differ significantly in their willingness to adopt companion robots, $F(1, 298) = 0.33$, p = .567, η^2 = .001, 90% CI [0.00, 0.02].[12]

Mediation Analyses

We report descriptive statistics and intercorrelations in Table 6.

We conducted two mediation analyses, one focusing on support for research on companion robots and the other on adoption of companion robots. In both analyses, the nostalgia manipulation (nostalgia condition = 1, control condition = 0) was the independent variable, with social connectedness and skepticism about change as parallel mediators.

Support for Research on Companion Robots. We specified a saturated model (Figure 5a). Nostalgia positively predicted social connectedness (b = 1.69, 95% CI [1.33, 2.05], SE = 0.18, p < .001, z = 9.17, b^* = .47), which in turn positively predicted support for research

[10] We conducted two pilot studies to arrive at the pictures. In Pilot Study 1, we asked 30 undergraduate students (15 women, 15 men, $M_{\text{age}} = 22.23$ years, $SD_{\text{age}} = 4.71$ years) at Beijing Normal University to upload five pictures of objects that make them feel nostalgic. We chose (with the help of a research assistant) 20 pictures based on three criteria: (1) no obvious social cues should be present in the pictures, (2) the objects should be mentioned by most participants as nostalgic, and (3) the objects appearing in the pictures should be common rather than rare. We also retrieved 20 neutral pictures from the internet that matched as closely as possible the nostalgic ones. In Pilot Study 2, we randomly assigned 57 undergraduate students (36 women, 21 men, $M_{\text{age}} = 21.92$ years, $SD_{\text{age}} = 5.14$ years) at the same university as in Pilot Study 1 to the nostalgia (n = 29) or control (n = 28) condition. Then, we presented them with the 20 relevant pictures in a separate random order. Subsequently, participants indicated whether each picture made them feel nostalgic (1 = not at all, 7 = very much) and whether they were familiar with the object in the picture (1 = familiar, 0 = unfamiliar). Participants rated the nostalgic pictures (M = 6.54, SD = 0.51) as more nostalgic than the neutral ones (M = 4.37, SD = 1.43), $F(1, 55) = 59.20$, p < .001, η^2 = .52. Further, they regarded the nostalgic (M = 17.86, SD = 1.53) and neutral (M = 18.29, SD = 1.01) pictures as approximately equally familiar, $F(1, 55) = 1.51$, p = .224, η^2 = .03, 90% CI [0.00, 0.13].

[11] In the pilot and formal studies, the familiarity rating was a count variable; however, one-sample Kolmogorov–Smirnov tests revealed that this variable did not follow a Poisson distribution, ps < .001.

[12] A one-sample Kolmogorov–Smirnov test revealed that the number of times (0–6) participants selected a companion robot (rather than a real pet) followed a Poisson distribution, p = .594. A Poisson regression indicated that nostalgic (M = 2.21, SD = 1.41) and control (M = 2.11, SD = 1.40) participants did not differ significantly in their willingness to adopt companion robots, b = 0.04, 95% CI [–0.11, 0.20], SE = 0.08, z = 0.58, p = .565, IRR = 1.04.

Table 6
Descriptive Statistics and Zero-Order Correlations Among Variables in Study 4

Variable	*M* (*SD*)	1	2	3	4	5
1. Nostalgia manipulation	0.50 (0.50)	—	.47***	.23***	.17**	.03
2. Social connectedness	4.19 (1.81)		—	.05	.42***	.29***
3. Skepticism about change	3.87 (1.28)			—	−.14*	−.17**
4. Support for research on companion robots	4.41 (1.22)				—	.36***
5. Adoption of companion robots	2.16 (1.41)					—

Note. Nostalgia manipulation: nostalgia condition = 1, control condition = 0. Correlations between dichotomous variables (variable 1) and continuous (variables 2–5) variables are point-biserial correlations. Correlations among continuous variables are Pearson correlations. Point-biserial and Pearson correlations are mathematically equivalent.
* $p < .05$. ** $p < .01$. *** $p < .001$.

on companion robots ($b = 0.29$, 95% CI [0.07, 0.31], $SE = 0.04$, $z = 7.25$, $p < .001$, $b^* = .42$). At the same time, nostalgia positively predicted skepticism about change ($b = 0.58$, 95% CI [0.29, 0.86], $SE = 0.14$, $z = 4.00$, $p < .001$, $b^* = .23$), which in turn negatively predicted support for research on companion robots ($b = –0.15$, 95% CI [–0.40, –0.20], $SE = 0.05$, $z = –3.01$, $p = .003$, $b^* = –.16$). The indirect effects via social connectedness ($ab = 0.48$, 95% CI [0.35. 0.66]) and skepticism about change ($ab = –0.09$, 95% CI [–0.18, –0.02]) were significant. When controlling for these directionally opposite indirect effects, the direct effect of nostalgia on support for research on companion robots ($b = 0.01$, 95 CI [–0.20, 0.28], $SE = 0.15$, $z = 0.09$, $p = .927$, $b^* = .01$) was not statistically significant.

We also tested the tenability of an equality constraint on the absolute magnitude of the respective indirect effects via social connectedness and skepticism about change. The equality constraint was not tenable. In terms of absolute magnitude, the indirect effect via social connectedness was significantly larger than the indirect effect via skepticism about change, Wald $\chi^2 = 17.51$, $df = 1$, $p < .001$. This finding supports the idea that, when AI technology is imbued with sociality, as companion robots are, the excitatory pathway via social connectedness acquires greater strength than the inhibitory pathway via skepticism about change.

Adoption of Companion Robots. We conducted a mediation analysis on adoption of companion robots using Mplus 7.0. We specified a saturated model (Figure 5b). Nostalgia enhanced social connectedness ($b = 1.69$, 95% CI [1.33, 2.05], $SE = 0.18$, $z = 9.17$, $p < .001$, $b^* = .47$), which in turn positively predicted companion robot adoption ($b = 0.27$, 95% CI [0.17, 0.36], $SE = 0.05$, $z = 5.58$, $p < .001$, $b^* = .23$). At the same time, nostalgia enhanced skepticism about change ($b = 0.58$, 95% CI [0.29, 0.86], $SE = 0.14$, $z = 4.00$, $p < .001$, $b^* = .23$), which in turn negatively predicted companion robot adoption ($b = –0.19$, 95% CI [–0.31, –0.07], $SE = 0.06$, $z = –3.04$, $p = .002$, $b^* = –.17$). The indirect effects via social connectedness ($ab = 0.45$, 95% CI [0.29. 0.65]) and skepticism about change ($ab = –0.11$, 95% CI [–0.21, –0.04]) were significant. When controlling for these directionally opposite indirect effects, the direct effect of nostalgia on companion robot adoption ($b = –0.25$, 95 CI [–0.60, 0.10], $SE = 0.18$, $z = –1.41$, $p = .157$, $b^* = –.09$) was not statistically significant.

Finally, an equality constraint on the absolute magnitude of the respective indirect effects via social connectedness and skepticism about change was not tenable. In terms of absolute magnitude, the indirect effect via social connectedness was significantly larger than the indirect effect via skepticism about change, Wald $\chi^2 = 10.34$, $df = 1$, $p = .001$. This is further evidence for a shift toward greater importance of the social connectedness pathway (relative to the skepticism pathway) when AI technology is imbued with sociality.[13]

Using a different manipulation of nostalgia, we replicated in Study 4 the results of Studies 2–3, bolstering the core of our model. Study 4 also supported the idea that, when AI technology is imbued with sociality, the social connectedness pathway is stronger than the skepticism pathway. Assuming no additional intervening processes, when the two opposing pathways differ in magnitude, the total effect will be dominated by the stronger of the two pathways. Indeed, Study 4 produced a positive total effect of nostalgia on support for research on companion robots—the excitatory social connectedness path dominated the total effect. The total effect of nostalgia on adoption of companion robots was positive as well, but not statistically significant.[14]

Internal Meta-Analysis

We conducted an internal meta-analysis, with R package *metaSEM*, of all studies to estimate the overall effect of each path in the dual-pathway model, namely that nostalgia mitigates favorable responses to AI technology via increased skepticism about change but promotes favorable responses to AI technology via increased social connectedness. For interpretability and ease of comparison, we computed all effect sizes as *r*s. When a study included multiple effect sizes for one specific path, we computed the average effect size within the study and used it in the meta-analysis. We present in Table 7 pooled correlation matrices for all studies. Given that the studies tested participants from three countries (China, United Kingdom, and the United States) and differed in their manipulations and measures, we implemented random-effects modeling.

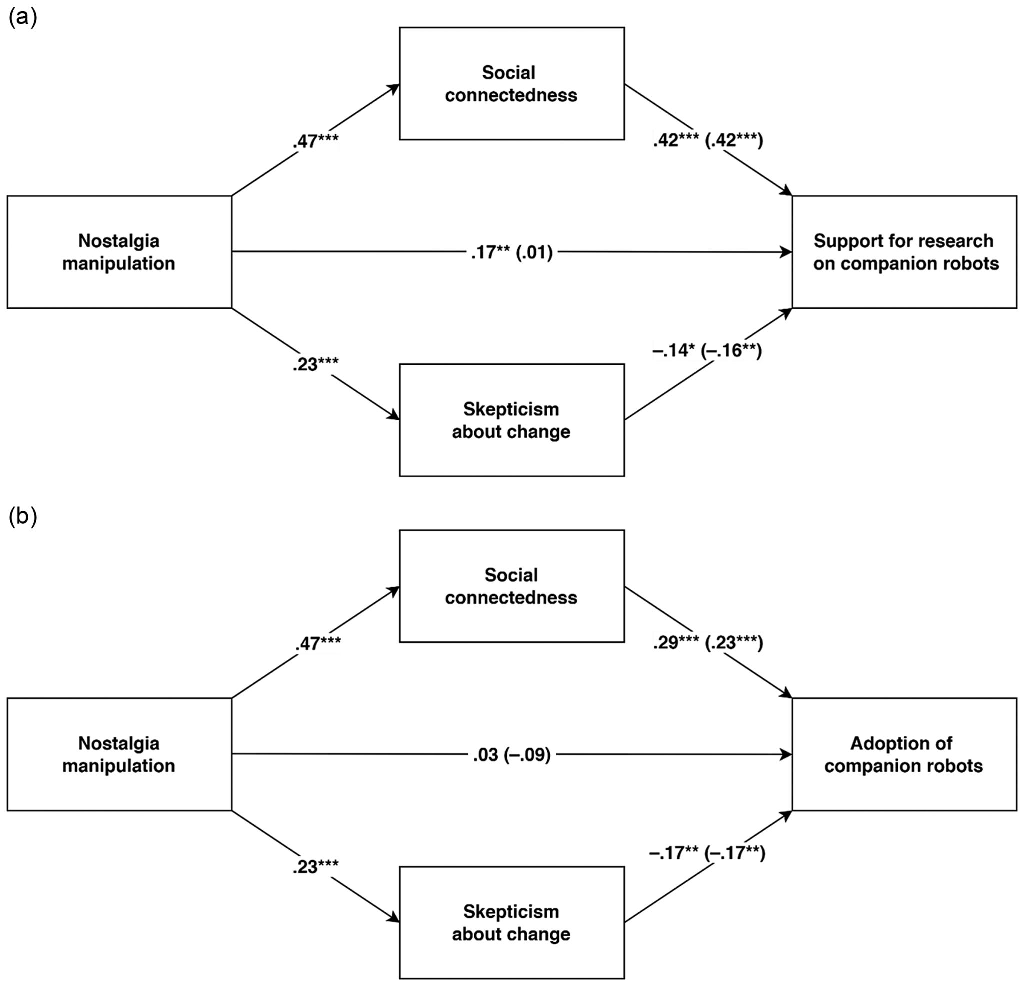
We conducted the analysis in two stages (M. W. L. Cheung, 2015). First, we estimated the pooled correlation matrix. We obtained a null overall association between nostalgia and responses to innovative technology ($r = .02$, 95% CI [–.04, .09], $z = .63$, $p = .527$). The associations of nostalgia with social connectedness ($r = .29$, 95% CI [.17, .41], $z = 4.64$, $p < .001$) and skepticism about

[13] In an ancillary mediation analysis on companion robot adoption, we specified a Poisson distribution for the dependent variable via the COUNT option in Mplus. Results were essentially identical to those reported.

[14] The nonsignificant total effect of nostalgia on adoption of companion robots may point to an additional, unmeasured inhibitory process to offset the dominant social-connectedness path. At the same time, the nonsignificant residual direct effect of nostalgia (i.e., the nostalgia effect after controlling social connectedness and skepticism about change) suggests that any such additional process would be minor (i.e., the to-be-explained residual effect is numerically small).

Figure 5

Effects of Nostalgia on Social Connectedness, Skepticism About Change, and (a) Support for Research on Companion Robots or (b) Adoption of Companion Robots in Study 4



Note. Nostalgia manipulation was coded: nostalgia condition = 1, control condition = 0. Coefficients are fully standardized. To enhance figure clarity, we omitted the correlated residuals between the two mediators (covariance = –0.13, 95% CI [–0.35, 0.10], SE = 0.11, p = .271). CI = confidence interval; SE = standard error.
* $p < .05$. ** $p < .01$. *** $p < .001$.

change (r = .24, 95% CI [.19, .30], z = 8.59, p < .001) were positive. Social connectedness was positively associated with responses to innovative technology (r = .23, 95% CI [.17, .30], z = 7.37, p < .001), and skepticism about change was negatively associated with responses to innovative technology (r = –.21, 95% CI [–.26, –.15], z = –7.09, p < .001). Social connectedness and skepticism about change were not significantly correlated (r = –.02, 95% CI [–.09, .04], z = –0.70, p = .483).

Second, we fitted the dual-pathway model with two mediators to the pooled correlation matrix. The model was saturated, as we examined paths among all variables. Nostalgia positively predicted social connectedness (b^* = .29, 95% CI = [.17, .41], z = 4.64, p < .001), which, in turn, positively predicted responses to innovative technology (b^* = .24, 95% CI = [.18, .30], z = 7.66, p < .001). Nostalgia positively predicted skepticism about change (b^* = .23, 95% CI = [.17, .30], z = 7.37, p < .001), which, in turn, negatively predicted responses to innovative technology (b^* = –.20, 95% CI [–.26, –.14], z = –6.68, p < .001). The indirect effect via social connectedness was positive (ab = .07, 95% CI [.04, .10]), and the indirect effect via skepticism about change was negative (ab = –.05, 95% CI [–.07, –.03]). After controlling for both social connectedness and skepticism about change, nostalgia did not predict responses to innovative technology (b^* = .00, 95% CI = [–.07, .07], z = –0.04, p = .969).

Besides the dual-pathway model with two mediators, we also tested two models with either social connectedness or skepticism about change as the mediator. The indirect effect via social connectedness was positive (ab = .07, 95% CI [.04, .12]), and the indirect effect via skepticism about change was negative (ab = –.05, 95% CI [–.07, –.03]).

Table 7
Effect Sizes (rs) Across Studies

Study No.	*N*	X_M$_1$	X_M$_2$	X_Y	M$_1$_M$_2$	M$_1$_Y	M$_2$_Y
1A	141					.26	
Supplemental Study S1	201					.26	
Supplemental Study S2	198					.19	
1B	200						−.26
2	298	.17	.27	−.05	−.09	.20	−.23
3	291	.23	.21	.02	−.03	.19	−.20
4	300	.47	.23	.10	.05	.36	−.15

Note. X = nostalgia; M$_1$ = social connectedness; M$_2$ = skepticism about change; Y = responses to AI technology. For studies with multiple dependent variables, we report averaged correlation coefficients; AI = artificial intelligence.

General Discussion

We addressed the relation between nostalgia and responses to innovative technology. How does nostalgia, a past-oriented but also forward-looking emotion, influence responses to new technology? Is nostalgia an obstacle to progress or a vehicle for it? It turns out it is both. We proposed a dual-pathway model that captures the duality of nostalgia (Figure 1). According to this model, nostalgia decreases the favorability of responses to innovative technology via increased skepticism about change. At the same time, nostalgia promotes the favorability of responses to innovative technology via increased social connectedness. In this regard, the dual-pathway model not only reconciles two seemingly competing perspectives, but also provides a novel framework to understand how yearning for the past influences the endorsement of technological progress.

Theoretical Implications

Our research elucidates the dual property of nostalgia, integrating its past-orientation (Hepper et al., 2012; van Tilburg et al., 2019) with its future outlook (Sedikides & Wildschut, 2016b, 2023). Nostalgia decreases favorable responses to innovative technology via skepticism about change, consistent with findings that nostalgia entails a preference for the past (Batcho, 1998; Osborn et al., 2022; Sedikides & Wildschut, 2018) and can be a barrier to accepting innovation (Fleury et al., 2021; Reisenwitz et al., 2007; Zhou et al., 2019). However, nostalgia increases favorability of responses to innovative technology via social connectedness, consistent with the notion that the emotion has implications for one's future (FioRito & Routledge, 2020; Sedikides & Wildschut, 2020).

The duality of nostalgia presents a unique opportunity to re-evaluate the ambivalent character of responses to innovative technology. The literature has depicted ambivalence toward innovative technology from a static perspective. Specifically, this literature captured ambivalent responding either at the between-person level (e.g., some people interpret robots as threat to humans, whereas others interpret them as opportunity; Allan et al., 2021; Dang & Liu, 2022a, 2022b) or the within-person level (e.g., a given person views technological agents as allies and enemies simultaneously; Dang & Liu, 2021; Maier et al., 2019). In adopting a dynamic perspective, we found that, when people experience as nostalgia, both their acceptance of and hesitancy toward innovative technology increase. Our perspective, then, extends prior theorizing on the topic.

Our model incorporates social connectedness and skepticism about change as two core opposing mechanisms, deepening our understanding of these constructs. On the one hand, our research extends work on the benefits of social connectedness into the psychology of technology. Social bonds often constitute the springboard for responding constructively to social threats, deficits in meaning in life, and interpersonal or intergroup conflicts (Hicks et al., 2010; Leary et al., 1995; Mikulincer & Shaver, 2007). We expanded this literature by demonstrating that social connectedness plays a constructive role in human−technology relationships. Thus, our findings contribute to the notion that social connectedness serves as a psychological resource for growth (Dang & Liu, 2023a; Feeney & Collins, 2015).

On the other hand, our research brings to the forefront the construct "skepticism about change." Although this variable significantly reduced support for research on AI and 5G technologies (demonstrating generality), Studies 1B and 3 revealed that the effect was stronger in the case of AI technology. Perhaps participants perceived AI technology as more innovative and disruptive than 5G technology, which might be viewed as an incremental progression from previous generations of wireless network standards. It seems plausible that skepticism about change would be more negatively related to support for disruptive than incremental innovation. The variable may similarly explain other phenomena associated with nostalgia, such as disapproval of outgroup (than ingroup) products (Dimitriadou et al., 2019), unhelpfulness to outgroup (compared to ingroup) members (Wildschut et al., 2014), and unfavorable attitudes toward immigrants (Smeekes et al., 2021). In all such cases, nostalgia-induced skepticism about change would inhibit favorability to unfamiliar objects or outgroups.

Practical Implications

Our research has practical implications as well. To begin, it informs strategies for overcoming psychological barriers to innovative technology. Considering the commercial potential, convenience, and well-being afforded by innovation, a sizable literature has examined how to strengthen favorability of responses to innovative technology. Prior work focused on two promising directions (Hancock et al., 2011). One pertained to human factors, such as self-efficacy in operating machines (Latikka et al., 2019) and user personality traits, with extraversion being linked to favorable attitudes and neuroticism to unfavorable ones (Damholdt et al., 2015). The other direction pertained to technological features, including robots' appearance (Mori, 1970), postures (Stein et al., 2022), and perceived mind (attributing to robots mental status such as the capacity to feel; Dang & Liu, 2021). In our research, we emphasized sociality. Nostalgia-induced social connectedness promotes favorability toward robotic devices.

In addition, our findings are relevant to the use of nostalgia as a marketing tool. Most literature on nostalgia in marketing addresses the purchase of products that evoke nostalgia or are accompanied by nostalgic labels (Muehling et al., 2014; Schindler & Holbrook, 2003; Zhou et al., 2019). Less is known about how nostalgia influences the endorsement of innovation. Our research revealed how trait- and state-level nostalgia can predict or influence responses to innovative technology. In part, our findings portrayed nostalgia as a roadblock to the acceptance of innovation. Therefore, using packaging with nostalgic cues or adding nostalgic labels may be ineffective for promoting the sales of innovative products. Alternatively, highlighting experiences of positive social interactions embedded in nostalgic reverie (e.g., sociality cues such as a gathering of friends who enjoy the product) is a promising strategy to increase consumer interest.

Limitations and Future Directions

Limitations of our research can inspire follow-ups. First, the relative strength of the two opposing mechanisms (skepticism about change and social connectedness) needs further investigation. When linking nostalgia to support for AI products that entail sociality (Study 4), the excitatory pathway via social connectedness was stronger than the inhibitory pathway via skepticism about change. When linking nostalgia to responses to AI products without explicit social cues (Studies 2 and 3), however, the excitatory pathway via social connectedness did not differ significantly from the inhibitory pathway via skepticism about change. Therefore, a promising line of research would involve testing systematically whether the relative strength of two pathways varies depending on whether AI products entail social connectedness.

The dual-pathway model warrants further development and extension. We included social connectedness and skepticism about change as core mechanisms underlying the opposing effects of nostalgia on responses to innovative technology. Follow-up studies would expand our model by examining how social connectedness facilitates responding to innovative technology (e.g., is it through exploration?) or how nostalgia-induced skepticism about change inhibits favorability to innovative technology (e.g., is it due to uncertainty)?

Finally, in terms of generalizability, follow-up studies could test our model with other innovative technologies, such as genome-editing (Watanabe et al., 2020) and augmented reality (Uymaz & Uymaz, 2022). Given that responses to innovative technology may vary cross-culturally in a nuanced way (Dang & Liu, 2021), future research should consider cultural differences in responses to technological innovation when testing the model.

In Closing

Writing half a century ago, the economist and diplomat Dag Hammarskjold saw concordance between valuing the past and the future: "The intensity of a man's faith in life can be gauged by his readiness to say yes to the past and yes to the future" (Hammarskjold, 1972, p. 98). We concur, although the empirical portrait, when it comes to nostalgia and acceptance of innovative technology, is more intricate. The emotion is characterized by valuing the past and being skeptical about the change that the future brings. At the same time, the emotion entails and fosters social connectedness, which instigates technology acceptance. This fascinating dual property of nostalgia and its implications for human–technology relationships are worthy of further theoretical and practical considerations.

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