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Research Report

The Framing Effect of Intergenerational Comparison of Technologies on Technophobia Among Older Adults

Wanyu Xi, MS,[1] Xin Zhang, PhD,[2,3,*] and Liat Ayalon, PhD[1]

[1]Louis and Gabi Weisfeld School of Social Work, Bar-Ilan University, Ramat Gan, Israel. [2]School of Psychological and Cognitive Sciences, Peking University, Beijing, China. [3]Beijing Key Laboratory of Behavior and Mental Health, Peking University, Beijing, China.

*Address correspondence to: Xin Zhang, PhD, School of Psychological and Cognitive Sciences, Peking University, 100871 Beijing, China. E-mail: zhang.x@pku.edu.cn

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Abstract

Objectives: Sharing similar negative age stereotypes (e.g., outdated, unfashionable), older adults and older technologies are stereotypically associated with each other. This also was found to be internalized by older adults. Recent research has suggested that internalized negative age stereotypes may be one of the reasons for technophobia among older adults. Therefore, considering the pervasiveness of intergenerational comparison of technologies (e.g., computer vs. tablet) in which older-generation technologies are negatively portrayed, we aim to investigate whether a mere intergenerational comparison of technologies would affect technophobia via negative self-stereotypes activation among older adults. Specifically, 2 commonly seen framings of intergenerational comparison of technologies are examined: contrast framing, which describes opposing intergenerational relationship of technologies; and connect framing, which describes the continuous intergenerational relationship of technologies.

Methods: We designed 3 advertisements for a made-up new technological product using contrast framing, connect framing, and neutral framing (where intergenerational comparison was absent). A sample of 284 participants (aged 27–83 years) was gathered online and randomly assigned into the 3 experimental conditions. Self-perception of aging (SPA), technophobia, and potential covariates were measured.

Results: The results showed a significant framing × age × gender effect on psychosocial loss dimension of SPA and technophobia. Men were significantly affected by the framing effect as they age, but women were not affected. Contrast framing (vs. connect vs. neutral framing) led to significantly higher technophobia via the psychosocial loss dimension of SPA among older men aged 49 and older.

Discussion: The findings have important implications for how to better convey persuasive information to promote new technology adoption among older adults.

Keywords: Age stereotype threat, Self-perception of aging, Technology

New technologies have sprung up rapidly in the past few decades and youth-oriented culture dominates technological development (McDonough, 2016). Older-generation technologies are often seen as outdated compared to new-generation technologies (Stremersch et al., 2009). On the other hand, older adults are often laggards in adopting new technologies and are also negatively stereotyped as low-competent and unfashionable relative to younger adults (Mariano et al., 2020). Sharing such similar negative age stereotypes, older adults and older technologies are thus stereotypically associated together, especially in the advertisements of new technologies. For example, in its serial

advertisements, MacBook was anthropomorphically played by a young teenager, who mocked at traditional personal computers (PCs) that were played by middle-aged and older men (Angus Lo, 2012). Some evidence had found that older adults also viewed traditional (vs. contemporary) products as more fit to their age identification (Amatulli et al., 2018), they even described themselves as "an old technology" when facing new technologies (Lillington, 2019), which represents the internalization of such ageist association.

Stereotype embodiment theory suggests that age stereotypes internalized from exposure to public media may cause a series of negative consequences to older adults (Levy, 2009). Recent research has suggested that in the technology domain, internalized negative age stereotypes among older adults may be one of the reasons for technophobia, an anxiety and overall negative attitudes toward technology (Hou et al., 2017; Köttl et al., 2021). A question follows: Would a mere intergenerational comparison of technologies affect technophobia via negative self-stereotypes activation among older adults? Considering that the impact of intergenerational comparison of technologies on older adults was previously neglected, and technophobia may impair older adults' well-being by preventing their engagement in society (Kim et al., 2017; Nimrod, 2020), it is important to investigate such a question. More specifically, we examine two framings of intergenerational comparison of technologies that can be commonly seen in public media. One is *contrast framing*, which describes older-generation technology being broken by newer-generation technology and emphasizes an opposing relationship between the two. The other is *connect framing*, which describes older-generation technology as the basis of newer-generation technology and emphasizes a continuous relationship between the two (Hoeffler, 2003; Luo et al., 2016). Examples can be found in one online marketing campaign, where iPad Air 4 was described as breaking the old iPad tradition, whereas iPad mini was described as carrying the old iPad tradition (Torres, 2020).

Previous research has found that intergeneration comparison of people, which increased the salience of negative age stereotypes, may activate negative age self-stereotypes among older adults (Abrams et al., 2006). Because older adults may associate themselves with the older-generation technologies (Lillington, 2019), we argue that intergenerational comparison of technologies, which conveys older-generation technologies' negative traits that are similar to older adults, may also be able to activate internalized negative age stereotypes among older adults. Furthermore, previous research indicated that activating internalized age stereotypes is often detrimental to self-perception of aging (SPA), also known as a person's view of their own aging process (Levy, 2009). SPA is multidimensional in nature and includes perceptions of age-related physical change, psychological growth (e.g., wisdom), and psychosocial loss (e.g., loneliness; Laidlaw et al., 2007). As intergenerational comparison of technologies describes the substitution of older-generation technologies by new-generation technologies and implies the obsolescence of older-generation technologies by society (Stremersch et al., 2009), it may thus be more ready to evoke SPA related to the psychosocial loss aspect, rather than the dimensions of physical change or psychological growth. Supporting evidence can also be found in interviews with older adults who expressed the feeling of "being left out" when new technologies became popular (Köttl et al., 2021).

Another vein of studies has found that changing perceived distinctions between groups may affect the salience of stereotypes and thus influence the stereotype activation and its negative consequences (Wheeler & Petty, 2001). Abrams et al. (2006) showed that more positive intergenerational relationships could reduce intergroup boundary and age stereotype activation, which further bring less anxiety among older adults engaged in cognitive tasks. Studies by Rosenthal and Crisp (2006) also found that reducing perceived distinctions between women and men decreased the salience of gender stereotypes, which further reduced the gender stereotype activation among women and its negative consequences. Thus, it can be inferred that contrast (vs. connect) framing that reflects more distinct intergenerational differences is more likely to activate negative age-based self-stereotypes and induce negative consequences among older adults.

Taken together, we proposed that:

H1: Intergenerational comparison of technologies with contrast framing (vs. connect vs. neutral framings) will lead to higher SPA on psychosocial loss (vs. physical change vs. psychological growth) as people age.

H2: Intergenerational comparison of technologies with contrast framing (vs. connect vs. neutral framings) will lead to higher technophobia via SPA on psychosocial loss as people age.

In addition, the effect of age stereotype activation on older people is often intertwined with gender stereotype activation (Gilbert et al., 2003; Roy & Ayalon, 2020). Research findings about gender differences in technology use and technophobia among older adults are inconsistent. Some reported that older men have more positive attitudes toward technology and higher technology engagement than women, but others reported the opposite or no gender differences (Ma et al., 2021; Pan & Jordan-Marsh, 2010). In addition, findings concerning the interaction effects of age and gender stereotype activation on technophobia are insufficient and ambiguous. We therefore propose the research question: Is there a gender difference in the effect between framing and age on technophobia?

Method

Participants

Sample size was determined by conducting a power analysis in G*power. It indicated that in testing the framing × age × gender effect on technophobia, a sample of 204

would be sufficient for an effect size of 0.048 to be detected with 80% power and significance level at .05 (see Supplementary Material for the calculation of effect size). A final sample of 284 participants based in China was recruited (M = 49.08; SD = 13.33; 50.7% women), including 24.9% young adults (aged 27–35 years), 48.6% middle-aged adults (aged 36–59 years), and 27.3% older adults (aged 60–83 years). Participants were recruited through an advertisement published on the most popular online social network platform in China.

Stimuli

According to the list of newly launched technology products on JD.com (the most popular e-commerce platform in China) during the period of our research, we selected the "smart lamp" as our experiment stimulus. We then designed three advertisements in Chinese for a made-up smart lamp ("Brand S") based on actual online advertisements of smart lamps, each using one of three different framings—contrast, connect, and neutral. Contrast framing described the features of the smart lamp that substantially deviated from the older-generation product, whereas connect framing described the features of the smart lamp that are upgraded from the older-generation product. Neutral framing only represented the smart lamp features. Supplementary Figure 1 shows the translated stimuli we used in the experiment. A pretest of the generation identity, and internalized age stereotype activation manipulation, was conducted. Results showed that the manipulation was valid (see Supplementary Material for details).

Procedure and Measures

The study passed the ethical approval of Peking University. Participants received a link to the online experiment from the experimenter on the social network platform. Next, each participant signed an informed consent form and was asked to fill his/her age and sex, to randomly assign them into one of the three conditions while balancing sex. After reading a corresponding advertisement, participants were asked to answer the survey questions.

We measured SPA using the Attitudes toward Aging Questionnaire (Laidlaw et al., 2007), technophobia based on the scale of Hou et al. (2017), demographics (self-rated health, self-reported socioeconomic status [SES]), and technology usage experience as potential covariates. All measures were adapted from scales that were proved valid in Chinese (see Supplementary Material for details). Participants received 5RMB for compensation.

Analytic Plan

To examine H1 and the research question regarding the gender effect, we tested the interaction effect of framing × age × gender on each dimension of SPA through structural equation modeling using bootstrapping in Mplus. Age was tested as a continuous variable, and framing and gender were dummy coded. Contrast framing was coded as the baseline (Framing 1: contrast vs. connect framing; Framing 2: contrast vs. neutral framing), as we were interested in comparing contrast framing with connect framing and neutral framing. Self-rated health, SES, and technology usage experience were included as covariates. To examine H2, we repeated the above analysis by replacing the dependent variable with technophobia. We then conducted a moderated mediation effect based on a 95% bias-corrected bootstrap analysis (5,000 samples), with technophobia being the dependent variable, framing the independent multicategorical variable, gender the moderator, and self-perception of psychosocial loss as a mediator. Potential covariates were included.

Results

Preliminary Analysis

The test of differences between framings and gender on age, self-rated health, SES, and technology usage experience was insignificant (ps > .05; Table 1).

Self-Perception of Aging

Results showed that on the SPA dimension of psychosocial loss, a significant effect of three-way interaction was found for both Framing 1 (b = 0.06, t = 1.89, p < .01) and Framing 2 (b = 0.08, t = 2.58, p < .05; Table 2). However, no significant three-way interaction effect was found on the other two dimensions of SPA (95% confidence intervals [CIs] include 0). A simple slope analysis revealed that both in Framing 1 and Framing 2, the effect of framing on perceived psychosocial loss was only significant among men who aged at mean level (age 49; Framing 1: b = −0.92, t = −3.33, p < .005; Framing 2: b = −0.61, t = −2.22, p < .05) and 1 SD above the mean level (age 62; Framing 1: b = −1.71, t = −4.33, p = .00; Framing 2: b = −1.54, t = −4.09, p = .00; Figure 1).

The Moderated Mediating Effect of Perceived Psychosocial Loss on Technophobia

Results showed that the main effect of age on technophobia was significant (b = 0.04, t = 2.49, p < .05; Table 2). More importantly, the three-way interaction effect on technophobia was significant for both Framing 1 (b = 0.08, t = 2.27, p < .05) and Framing 2 (b = .06, t = 1.92, p = .05). It also showed that the effect of framing × age was only significant among men (p < .01) rather than women (p > .05). A simple slope analysis showed that the framing effect was significant only among men who aged 49 (Framing 1: b = −0.67, 95% CI = [−1.27, −0.07]; Framing 2: b = −0.90,

Table 1. Sample Characteristics at Baseline by Experimental Condition

	Contrast framing		Connect framing		Neutral framing			
	Male (N = 45)	Female (N = 47)	Male (N = 47)	Female (N = 49)	Male (N = 48)	Female (N = 48)	F	p
Age	48.20 (13.01)	49.08 (12.19)	48.98 (14.99)	49.27 (12.40)	50.75 (14.06)	48.60 (13.50)	0.27	.76
Self-rated health	6.02 (1.74)	6.40 (1.54)	6.34 (1.46)	6.51 (1.54)	6.06 (1.62)	6.13 (1.72)	0.24	.79
Self-reported socioeconomic status	4.78 (1.94)	5.17 (1.86)	4.83 (1.74)	5.24 (2.20)	4.96 (2.03)	5.23 (1.57)	0.04	.96
Technology usage experience	5.64 (1.92)	6.38 (1.58)	5.98 (1.61)	6.00 (1.83)	5.85 (1.84)	5.83 (1.81)	1.40	.25

Notes: M = mean; SD = standard deviation. Means are outside the parentheses, and SDs are within the parentheses.

Table 2. Interaction Effect of Framing × Age × Gender on Each Dimension of Self-Perception of Aging and Technophobia

	Self-perception of psychosocial loss		Self-perception of psychological growth		Self-perception of physical change		Technophobia	
Independent variable	b	SE [95% CI]	b	SE [95% CI]	b	SE [95% CI]	b	SE [95% CI]
Framing 1	1.99	1.10 [0.20, 3.90]	0.09	0.76 [−1.14, 1.38]	−0.46	0.75 [−1.71, 0.81]	2.84**	1.14 [0.60, 5.08]
Framing 2	2.84*	1.23 [0.85, 4.81]	−0.24	0.78 [−1.46, 1.15]	−1.12	0.68 [−2.25, −0.01]	1.43	1.17 [−0.87, 3.73]
Age	0.04*	0.02 [0.02, 0.07]	0.00	0.01 [−0.02, 0.02]	0.01	0.01 [−0.02, 0.03]	0.04*	0.02 [0.01, 0.08]
Framing 1 × Age	−0.06**	0.02 [−0.10, −0.02]	−0.01	0.02 [−0.03, 0.02]	0.01	0.02 [−0.02, 0.03]	−0.07**	0.02 [−0.12, −0.03]
Framing 2 × Age	−0.07**	0.02 [−0.11, −0.03]	0.01	0.02 [−0.02, 0.03]	0.02	0.01 [−.00, 0.04]	−0.05*	0.02 [−0.09. −0.00]
Gender	1.62	1.22 [−0.34, 3.68]	−0.00	0.95 [−1.64, 1.40]	−0.85	0.91 [−2.28, 0.57]	0.93	1.22 [−1.46, 3.33]
Framing 1 × Gender	−2.02	1.68 [−4.63, 0.78]	−1.51	−1.29 [−3.66, 0.57]	0.04	1.20 [−2.00, 1.99]	−2.97	1.68 [−6.27, 0.33]
Framing 2 × Gender	−2.99	1.63 [−5.74, −0.46]	0.50	1.19 [−1.47, 2.44]	1.98	1.11 [0.16, 3.76]	−2.04	1.65 [−5.29, 1.20]
Age × Gender	−0.05*	0.02 [−0.09, −0.02]	−0.00	0.02 [−.03, 0.03]	0.02	0.02 [−0.01, 0.05]	−0.04	0.02 [−0.09, 0.01]
Framing 1 × Age × Gender	0.06*	0.03 [0.01, 0.11]	0.03	0.03 [−0.01, 0.08]	0.00	0.03 [−0.04, 0.04]	0.08*	0.03 [0.01, 0.14]
Framing 2 × Age × Gender	0.08*	0.03 [0.03, 0.14]	−0.01	0.02 [−0.05, 0.03]	−0.04	0.02 [−0.08, −0.00]	0.06*	0.03 [0.00, 0.13]
Self-rated health	−0.12	0.07 [−0.22, −0.01]	0.16**	0.06 [0.07, 0.25]	0.31***	0.05 [0.23, 0.40]	−0.08	0.06 [−0.179, 0.04]
Self-reported socioeconomic status	−0.08	0.05 [−0.16, 0.00]	0.10*	0.04 [0.03, 0.17]	0.08*	0.03 [0.03, 0.14]	−0.10	0.05 [−0.20, 0.01]
Technology usage experience	−0.04	0.06 [−0.14, 0.05]	0.27***	0.05 [0.19, 0.35]	0.21***	0.05 [0.14, 0.29]	−0.06	0.06 [−0.17, 0.05]

Notes: CI = confidence interval; SE = standard error. Coding of Framing 1: contrast framing = 0, connect framing = 1, neutral = 0; Framing 2: contrast framing = 0, connect framing = 0, neutral = 1; gender: male = 0, female = 1.
*p < .05, **p < .01, ***p < .001.

95% CI = [−1.49, −0.30]), as well as among men who aged 62 (Framing 1: b = −1.62, 95% CI = [−2.49, −0.76]; Framing 2: b = −1.53, 95% CI = [−2.37, −0.69]; Figure 2). On the other hand, in the contrast framing condition, age was positively associated with technophobia among men (b = 0.04, t = 2.49, p < .05); in the connect framing condition, age was surprisingly negatively associated with technophobia among men (b = −0.03, t = −1.91, p = .05); in the neutral framing condition, age showed no significant effect on technophobia among men (p > .05; see Supplementary Material for one-sided Bayesian hypothesis test).

Results of the moderated mediation test also showed that indirect effect of perceived psychosocial loss on technophobia was significant only among men aged 49 for both Framing 1 (b = −0.37, 95% CI = [−0.63, −0.13]) and Framing 2 (b = −0.25, 95% CI = [−0.51, −0.02]), as well as among men aged 62 for both Framing 1 (b = −0.70, 95% CI = [−1.14, −0.33]) and Framing 2 (b = −1.54, 95% CI = [−1.00, −0.31]). The moderated meditation effect was not significant among younger men aged below 49 or women (95% CIs include 0; Figure 3).

Connect framing and neutral framing were also tested following the same procedures, but none of the results were significant (see Supplementary Figure 2 and Supplementary Table 1 for details).

Discussion

Taken together, the present research revealed that intergenerational comparison of technologies may indeed activate internalized negative age stereotypes among older adults and induce negative psychological consequences. Specifically, intergenerational comparison of technologies with contrast framing (vs. connect vs. neutral framing) was more likely to activate internalized age stereotypes among older men (vs. older women), which was manifested as a

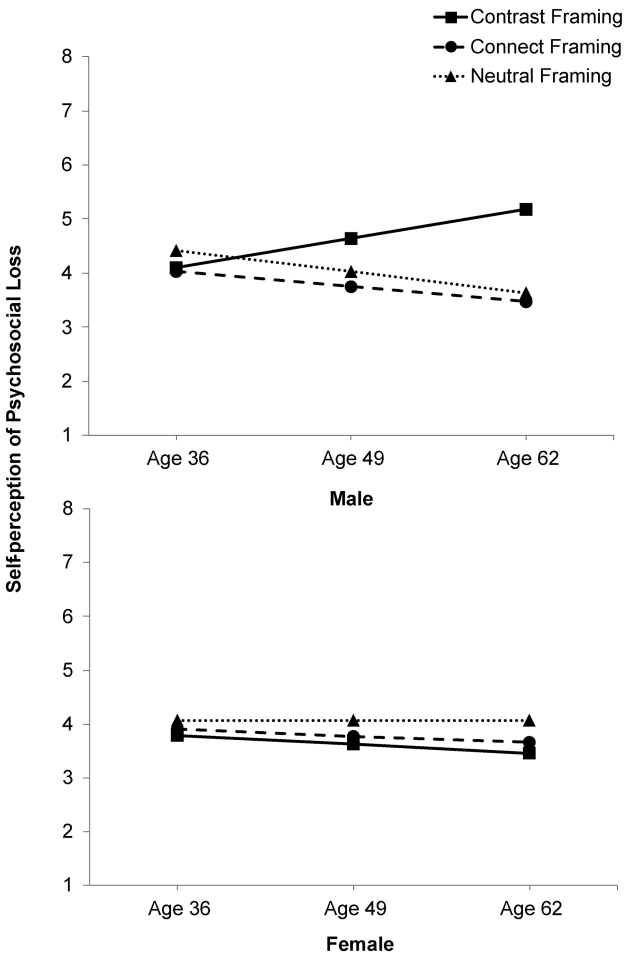

Figure 1. The framing differences on self-perception of psychosocial loss with age.

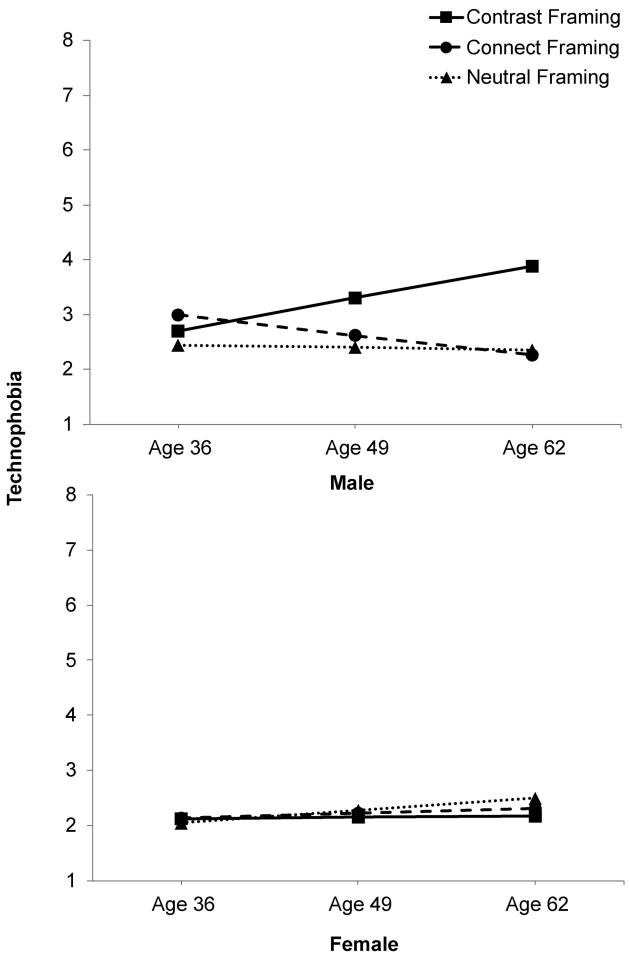

Figure 2. The framing differences on technophobia with age.

much higher perceived psychosocial loss, and further induced higher technophobia. By finding a new source of age stereotype activation, which is pervasively existing but was previously overlooked, our finding supports the stereotype embodiment theory (Levy, 2009).

One important finding of this study concerns the gender difference that men (vs. women) were more negatively affected by the framing as they age. Such a result is opposite to what one might expect: that older women facing negative age and gender stereotypes are supposed to experience higher stereotype threats (Mariano et al., 2020; Pinquart & Sörensen, 2001). One explanation for our finding stems from previous findings that stereotyped group members with more positive self-identification tend to be more likely to experience stereotype threat, whereas those with lower confidence might be more prone to disidentify with the domain for the purpose of self-protection (Spencer & Steele, 1999; Wheeler & Petty, 2001). Older men, who have generally been found to have less negative self-identity and greater confidence in technology-related domains than older women (Gilbert et al., 2003), are more likely to be threatened by age stereotypes. Another explanation might be found in the study of Martin et al. (2019), who examined prescriptive stereotypes and found that compared to older women, older men faced stronger prescriptive stereotypes that older people should not behave agentically. This is suggested by a recent national survey in China, which has found that older men are less actively engaged in social activities (including technology adoption behavior) than older women (Ru et al., 2018). Therefore, contrast framing that implies the less agentic role of the older generation in society is more highly endorsed by older men than older women, which further induces a higher stereotype threat (Barber, 2017). However, because we did not measure self-concept-related variables, such as self-esteem, subjective age, and self-identity (Pinquart & Sörensen, 2001), the underlying mechanism of framing × gender effects was unclear. Future research should uncover it.

On the other hand, previous research has shown that technophobia was correlated with demographic background (e.g., age, gender, education, physical health; Gilbert et al., 2003; Nimrod, 2018), dispositional traits (e.g., openness, neuroticism, extraversion), and cognitive processing skills (e.g., math and logic skills; Korukonda, 2005; Maricutoiu, 2014). Age was particularly addressed by numerous studies and has been found to be positively related to technophobia (Dos Santos & Santana, 2018).

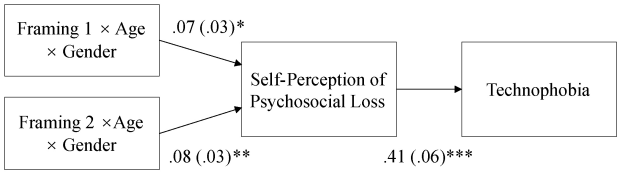

Figure 3. The moderated mediation effect of self-perception of aging. Note: ***$p < .001$ and *$p < .05$. Unstandardized estimates are outside the parentheses and standard error is within the parentheses. Coding of Framing 1: contrast framing = 0, connect framing = 1, neutral = 0; Framing 2: contrast framing = 0, connect framing = 0, neutral = 1; gender: male = 0, female = 1.

However, our research demonstrated that the relationship between age and technophobia varied across different framings among men (Figure 2), which implies the importance of situational factors, namely the framings of intergenerational comparison of technologies, on technophobia. More importantly, by finding the mediation effect of age stereotype activation between the framings and technophobia among older men, our research contributed to the line of research on technophobia that internalized age stereotype may also be a reason for technophobia specifically among older men.

Because our sample was based in China, which is characterized by generally positive aging attitudes compared with Western culture (Tan & Barber, 2020), replicating the study in Western populations is important. It could also be possible that technophobia serves as the mediator between the relationship between intergenerational comparison of technologies and self-perception of psychosocial loss among older adults (refer to Supplementary Material for further analysis and discussion). Future qualitative explorations might help identify a more detailed psychological mechanism among older adults to reduce technophobia in this population. Despite these limitations, the findings of this research provide specific implications, that is, avoiding the description of opposing intergenerational relationship of technologies in the promotion or introduction of new technologies may help to reduce technophobia among older adults, which may further encourage their new technology adoption, especially for older men.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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Conflict of Interest

None declared.

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