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How age-morphed images make Me feel: The role of emotional responses in building support for seniors



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ABSTRACT

This study examined the role of emotional responses to experiencing age-morphed images in promoting individuals' attitudes toward seniors and behavioral intentions to support senior-related issues. We investigated whether temporal status (i.e., current vs. future) manipulated by using age-morphing technology and the subject of images (i.e., self vs. other) elicited different emotional responses-personal distress and empathic concern. Drawing on the perspective-taking framework, we tested these emotional responses as an underlying mechanism to explain the seemingly ambivalent effects of age-morphing technology. A laboratory and an online experiment was conducted on different samples: Study 1 on university students and Study 2 on an extended population sample with ages ranging from 21 to 52 years. The findings for Study 1 revealed that university students exhibited a greater level of personal distress when they saw an age-morphed image, which led to unfavorable attitudes toward seniors. The results of Study 2 revealed that, when people saw an age-morphed image of another person, they showed greater empathic concern than when seeing their old future image, which served as a moderated mediator leading to favorable attitudes toward seniors and behavioral and financial support for the senior-related issues. Unlike the finding of Study 1, the increased personal distress led to positive outcomes. In addition, participants exhibited greater empathic concern, which led to a higher level of supportive intentions. The results demonstrated both emotional responses could operate as potential effects of age group, generating different outcomes. We discuss the theoretical and practical implications.

1. Introduction

The world's senior population is growing rapidly, and the potential ramifications of such a shift require attention and public action. In a report, titled *World Population Ageing* (World Health Organization, 2018), the number of seniors (i.e., those over 60 years of age) is projected to increase by 55% and reach 2 billion globally by 2050, comprising approximately 22% of the world's population. The exponential growth of the senior population is anticipated to entail diverse issues at personal (e.g., poverty from reduced economic capacity, physical inability, and diseases) and societal levels (e.g., labor shortages, economic recession, and burgeoning health care expenses; Chand & Tung, 2014; World Health Organization, 2015). Yet many people,

particularly young and early middle-aged adults (i.e., Millennials and early Generation Xers¹), are not suitably prepared to face the issues of an aging society. They often segregate themselves from older people and hold negative attitudes toward them, which can lead to age discrimination in daily life, as well as in the workplace (Brownell & Kelly, 2013; Nelson, 2005). Reducing negative stereotypes and attitudes toward seniors and generating support among people for senior-related issues are crucial endeavors.

Virtual technologies have garnered attention as potential communication tools for raising awareness of negative consequences and promoting healthier choices and wiser intertemporal decision-making. Particularly, future-related technologies have demonstrated their potential influence on individuals' attitude and behaviors by providing

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¹ Millennials refers to people who were born between 1981 and 2004 (Strauss & Howe, 1991), and Generation Xers indicate people who were born between 1965 and 1980 (Dimock, 2019).

individuals with a direct and vivid experience of having a different physical condition or identity (Ahn, Le, & Bailenson, 2013; Oh, Bailenson, Weisz, & Zaki, 2016). For example, researchers have found that age-morphed avatars or images facilitate people's intentions to save money for the future (Hershfield et al., 2011) and reduce delinquent behaviors (Van Gelder, Luciano, Weulen Kranenbarg, & Hershfield, 2015). In addition, age-morphing technology can lead people to have empathy and sympathy for seniors, positively affecting their attitudes toward and intentions to support senior-related issues (Lee, 2017; Yee & Bailenson, 2006). However, contradicting this research, Rittenour and Cohen (2016) revealed that age-morphed images elicited negative emotions and heightened negative stereotypes of the seniors.

Therefore, to enhance our understanding of the effects of futurerelated technology, the researchers examined the effect of temporal status manipulated by age-morphing technology by using different subjects (i.e., self and other/stranger), as well as the mediating role of emotional responses (i.e., personal distress and empathic concern). Drawing upon the perspective-taking framework and emotional responses literature (Batson et al., 1987; Eisenberg et al., 1989; Eisenberg & Eggum, 2009), we proposed emotional responses as a potential underlying mechanism and investigated their mediation and moderated mediation effects. In Study 1, we conducted a laboratory experiment to test main and interaction effects of temporal status and subjects of images on emotional responses. We subsequently tested the simple and conditional indirect effects of the emotional responses on the relationship temporal status and individuals' attitude toward and behavioral intentions to support senior-related issues depending on the subject of images. In Study 2, we conducted an online experiment to test the same relationships by using a sample of an extended population to cover different demographic segments.

Although the extant body of research on senior population has addressed digital media's use in practice, scholarship on the use of virtual reality techniques is nascent. This study attempts to make an original contribution to the body of knowledge in age-morphing technology in relation to scholarly literature from the framework of perspectivetaking (Batson, Early, & Salvarani, 1997). The findings of the study will contribute to using visual representation of future selves in senior-related issue campaigns to enhance young generations' and early middle-aged adults' perspective-taking skills and reduce their negative stereotypes of senior population.

2. Literature review

2.1. Age-morphed technology and its ambivalent effects

Age-morphing technology is an emerging technology that allows young people to experience visually their future through vivid, ageprogressed images, possibly influencing their perceptions of and attitudes toward seniors, as well as their behaviors pertaining to seniorrelated issues (Lee, 2017). Age-morphing technology shows a person's physical appearance, in the form of a photograph, video, or avatar in virtual platforms, as it gradually ages (Rittenour & Cohen, 2016). The age-morphed images provide a visual representation of a person's potential future appearance by showing his or her current image with wrinkles, lumpy and darkened skin, and gray hair. These vivid and realistic visual representations generated by age-morphing technology have presented their unique potential as an effective tool for influencing people's perceptions of and attitudes toward seniors.

Research has revealed that experiencing aging by using morphing technology can contribute to reducing negative perceptions of and attitudes toward seniors and even promote helping behaviors toward seniors (Lee, 2017; Oh et al., 2016; Yu & Chen, 2012). Experiencing one's future virtually through age-morphed images or avatars could lead to realizing and understanding the future as imminent by developing psychological continuity with one's future self and activating concrete construals related to future consequences (Lee, 2017). Getting close to one's future as a senior helped young people identify seniors as an in-group, thus increasing empathy and sympathy and reducing ageism. Consequently, this group identification elicited psychological proximity to senior-related issues and led to favorable attitudes toward and supportive behaviors for seniors (Lee, 2017). Age-progressing technology also allowed people to have feelings about one's potential future by providing a chance to observe how one might appear as an older person (Lee, 2017). Feelings such as empathy can influence people's attitudes toward and supportive behaviors toward seniors (Lee, 2017; Oh et al., 2016). Similar results were found through online games that allowed people to experience the life of an older person who experiences physical difficulties, which generated increased understanding of and empathy for seniors (Henry, Ozier, & Johnson, 2011; Varkey, Chutka, & Lesnick, 2006).

However, age-morphing technology seems to create ambivalent effects by also negatively affecting individuals' attitudes toward seniors and behavioral intentions for senior-related issues. Rittenour and Cohen (2016) revealed that exposing people to age-progressed images of self-generated negative affect and anxiety fostered negative stereotypes of seniors. Those experiencing their future through vivid images can be reminded of potential future hardships and threats they might face (Oh et al., 2016). These thoughts about negative future experiences can elicit a negative emotional response and reinforce preexisting negative perceptions of seniors, subsequently leading to unfavorable attitudes toward them and less willingness to support senior-related issues (Rittenour & Cohen, 2016). The findings demonstrated that certain emotional responses to age-morphing technology could result in negative technological outcomes, eliciting negative perceptions of, attitudes toward, and behavioral intentions for seniors. Therefore, to understand the ambivalent effects of age-morphing technology, it is critical to understand the types of emotional responses people express from being exposed to age-morphed images and how those emotional responses might affect the technology's effects.

2.2. Perspective-taking framework and emotional responses

The effects of age-morphed images on people's thoughts about seniors can be explained with two ways of perspective-taking process and corresponding emotional responses. According to the literature on perspective-taking and emotional responses, there are two approaches to understand the perspectives of others in need: imagining oneself in a difficult situation and imagining a person's feelings in the difficult situation (Batson et al., 1997). These two approaches to understanding other people's situations can induce two distinct emotional responses-personal distress and empathic concern (Batson, Fultz, & Schoenrade, 1987). Personal distress refers to an aversive emotional state or condition that results from thinking about another's suffering and hardships (Batson et al., 1987; Davis, 1983). In contrast, empathic concern is an emotional state based on appreciating another's suffering (Batson et al., 1987; Davis, 1983; Eisenberg & Fabes, 1990). Because age-morphed images that vividly depict potential future appearance would remind of future difficulties and threats people might face as a senior (Oh et al., 2016), we expect that age-morphed images would lead people to feel higher levels of negative emotional responses, that is, personal distress and empathic concerns, compared to images that show current appearance. Thus, it is hypothesized:

H1. People who see an age-morphed image will exhibit greater (a) personal distress and (b) empathic concern than those who see a current image.

In addition, our prediction is that people would generate different levels of personal distress and empathic concerns, depending on the subject of age-morphed image (i.e., self vs other), Prior research has revealed that, when people imagine themselves in a difficult situation, they tend to feel greater personal distress, whereas, when people think about others' feelings in a tough situation, they tend to have greater empathic concern (Batson et al., 1997; Eisenberg & Eggum, 2009). That is, the exposure to an image of one's potential future can elicit personal distress, reminding people of the potential difficulties they might face as seniors, such as financial crises, health problems, ageism, and mistreatment. On the other hand, when people see an age-morphed image of another person, they can feel greater empathic concern by thinking about that person's difficulties and suffering as an older person. Therefore, we hypothesized:

H2. People who see an age-morphed image of themselves will exhibit greater personal distress than those who see an age-morphed image of another person.

H3. People who see an age-morphed image of another person will express greater empathic concern than those who see an age-morphed image of themselves.

Previous research has shown that one of these emotional responses appears to be dominant over the other during the perspective-taking process, thus inducing different prosocial behavior motivations (Eisenberg et al., 1989). Personal distress evokes egoistic motive, whereas empathic concern elicits altruistic motives for helping behaviors (Batson et al., 1987; Batson, O'Quin, Fultz, Vanderplas, & Isen, 1983). Researchers have found that these two seemingly contradictory motives promote helping behaviors for either self-protective or other-benefiting motivations (Cialdini et al., 1987; Cristea et al., 2014). More specifically, egoistic motive led by personal distress drives prosocial actions to avoid aversive arousal and alleviate one's discomfort. Such motivations also can facilitate helping behaviors for self-serving reasons, such as to seek self-benefits and gratification or to increase one's own welfare (Batson, 1987). Conversely, altruistic motivation elicited by empathic concern promotes other-benefiting actions to increase others' welfare and relieve them of suffering (Batson, Duncan, Ackerman, Buckley, & Birch, 1981). Even though both emotional reactions of perspective-taking can lead to helping behaviors, some researchers have found that personal distress enhances moral disengagement, facilitating self-centered behaviors, rather than helping behaviors (Paciello, Fida, Cerniglia, Tramontano, & Cole, 2013).

The effects of personal distress and empathic concern on prosocial actions can vary depending on factors related to helping actions and situations. Batson et al. (1981) demonstrated that people who have egoistic motives were unlikely to engage in helping actions when the cost of helping is high and avoidance is easy, whereas people with altruistic motives in the same situation still choose to help, rather than escape when facing the same situation. When personal distress prevails over empathic concern, self-protecting motivation is triggered, which leads to helping behaviors to alleviate one's discomfort. In this situation, helping behaviors were performed least when people thought the action would not reduce their pains. In contrast, people more engaged in helping behaviors when they believed their discomfort would not disappear unless they helped (Carrera et al., 2013; Stocks, Lishner, & Decker, 2009). These findings imply a relatively weak association between personal distress and prosocial behaviors, which does not always guarantee subsequent helping behaviors, compared to the stronger connection between empathic concern and helping behaviors.

Therefore, according to the literature on the effects of age-morphing technology and perspective-taking framework, we expect individuals who see an age-morphed image of themselves feel greater personal distress, and to relieve this negative affect, they can be motivated to become involved in positive actions, such as helping seniors. However, the negative affect also can discourage people's attitudes toward and engagement in supportive intentions for seniors. Our prediction is that people feel greater empathic concern when they are exposed to an agemorphed image of another person, and the feeling of empathy can positively influence their attitude toward seniors and behavioral intentions to support senior-related issues for altruistic motives. Therefore, both personal distress and empathic concern generated by experiencing age-morphed images of oneself and others can serve as mediators. Considering that different levels of temporal status and subjects of images are expected to influence emotional reactions, we hypothesized the moderated mediating effects of emotional responses. Therefore, we proposed the following hypotheses:

H4. Under the image of self-conditions, personal distress will mediate the relationship between temporal status and (a) attitude toward seniors and (b) participation intention and (c) donation intention to support seniors.

H5. Under the other image conditions, empathic concern will mediate the relationship between temporal status and (a) attitude toward seniors and (b) participation intention and (c) donation intention to support seniors.

2.3. Study 1: laboratory experiment with college students

2.3.1. Participants and sample

We employed a 2 (the subject of image: self vs. other) x 2 (temporal status of image: current vs. future) between-subject factorial design. To conduct a laboratory experiment, we recruited 136 undergraduate students from a college research pool in exchange for extra credit. From the initial 150 participants, we removed seven participants who spent less than 10 min to secure a quality sample and maximize the reliability of the results. To assure rigorous hypothesis testing, we also excluded seven participants who realized the purpose of the study by analyzing their answers about awareness questions,² leaving the total sample as 136.

A total of 81.6% of the participants were female and 18.4% were male. The sample skews more toward females than the average gender proportion of millennials. The gender imbalance might have resulted from the fact that the research pool was limited to college students, where female students outnumber male students (Bui, 2014). All participants are millennials (M = 20.96, SD = 1.57, age range = 18–27). Demographically, the sample is 50% Caucasian/White, 28.7% Hispanic/Latino, 8.8% African American, and 8.1% Asian, which reasonably reflects the U.S. millennial population (Census, 2015).

2.3.2. Stimuli and procedure

To create stimuli for the image of self conditions, we collected current pictures of the participants, approximately three days before the laboratory experiment. In Study 1, we used an age-morphing software program from AprilAge Inc. (https://aprilage.com), which allowed age morphing that captures patterns of facial characteristics related to gender, ethnicity, and age, based on its database and improves the quality of age-morphed images (see Appendix; Hubball, Chen, & Grant, 2008). Using the age-morphing software, we morphed participants' current pictures to generate future images to show what they would look like in their 60s and 70s. For other current conditions, we created six pictures of strangers with race and gender (i.e., Caucasian male; Caucasian female; African-American male; African-American female; Asian male and Asian female). For other future conditions, we used an age-morphed version of those same six pictures. To generate the best quality age-morphed images using the software, we asked participants to strictly follow an instruction about the general format of pictures, posture, and size of the figure in a photo, based on the website's

² During the online experiment, participants were asked to answer four questions to indicate their understanding of the purpose of the study and tasks (e.g., "what do you think this experiment is trying to study?" "Did anything you did on one task affect what you did on any other tasks? If yes, how exactly did it affect you?"). Seven participants, who clearly answered that this study aims to test the effects of experiencing age-morphed images on attitudes toward the seniors and intentions to help seniors, were excluded to avoid chances to include responses that had intention to meet the expectations of the study.

guidelines (https://aprilage.com/ageme-step-1/).

We instructed participants to share photos of themselves in advance to generate the stimuli. When participants came to a laboratory, we randomly assigned each participant to one of four conditions—an image of current self, future self, current other, and future other. In the currentself condition, we presented participants with an image of their current selves; in the current-other condition, an image of another person's current appearance; in the future-self condition, an age-morphed image of themselves; and in the future-other condition, an image of another's future appearance. We instructed them to carefully view the image and then complete a questionnaire that measured their emotional response to the image, attitude toward seniors, and behavioral intentions to support senior-related campaigns.

2.3.3. Measures

Emotional responses. We assessed the participants' emotional responses to stimuli by measuring their level of empathic concern and personal distress using existing scales of the concepts (Batson et al., 1987;Lovell, 2006). The index for empathic concern included six adjectives (warmth; softhearted; tenderness; moved; compassionate; and sympathetic), and the personal distress index consisted of six adjectives (upset; grieved; sorrow; distressed; worried; and anxious). We asked the participants to express their degree of feeling related to these adjectives on a 7-point Likert scale (1 = not at all, 7 = extremely), and the ratings were averaged to form their emotional responses.

Attitude toward seniors. We used two types of questions to measure participants' attitude toward seniors. We employed four 7-point semantic differential scales (Tam, Hewstone, Harwood, Voci, & Kenwor-thy, 2006). We asked participants to express the degree to which they felt negative-positive, friendly-hostile, contempt-respect, and admirable-disgust attitude toward seniors.

Behavioral intention to support **senior-related campaigns.** We measured behavioral intentions to support and donate to senior-related campaigns by using six 7-point Likert scales. Participants were asked to indicate their level of willingness to communicate about senior-related issues and dedicate time and money to support senior-related campaigns.

Donation intention to support **senior-related campaigns.** To measure the participants' donation intention to address senior-related issues, we asked them to indicate how much money they were willing to donate to senior-related campaigns if they had \$100 allocated to give. We asked them to drag a slide bar that ranged from \$0 to \$100 to answer the question.

2.3.4. Results

Main effects of temporal status. Analysis of variance (ANOVA) was conducted to test the main effects of temporal status on personal distress (H1a) and empathic concern (H1b). The findings showed a significant mean difference between two groups that were exposed to either a current or a future image on personal distress. People who were exposed to an age-morphed image presented a higher level of personal distress (M = 3.74, SD = 1.52) than people who saw a current image (M = 2.26, SD = 1.34), F (1, 134) = 36.13, p < .001, $\eta^2_p = .21$, supporting H1a. However, there was no significant main effect of temporal status on empathic concern (p > .05). There was no significant mean difference of empathic concern between college students who saw an age-morphed image generated significantly higher personal distress, but not empathic concern, compared to a current image.

Interaction effects of temporal status and subject of images on emotional responses. ANOVA was used to test the interaction effects of temporal status and subjects of images on emotional responses (H2 and H3). The results revealed no significant two-way interaction between temporal status and subjects of image, neither on personal distress (p > .05) nor empathic concern (p > .05). That is, people who saw their age-progressed image did not have a significantly higher level of personal

distress than people who saw an age-morphed image of another person. In addition, people who saw an age-morphed image of another person did not express a significantly higher level of empathic concern than people who saw an age-progressed image of themselves. Thus, H2 and H3 were not supported.

Moderated mediation effects of empathic concern. The insignificant results of the interaction effects between temporal status and subject of images on emotional responses weakened the basis of testing the moderated mediation effects of personal distress and empathic concern (H4 and H5). However, we tested the moderated mediation effects by using PROCESS model 7 (Hayes, 2013) First, we coded the temporal status of images (0 = current and 1 = future) and the subject of the images (0 = self and 1 = other). Second, we ran the analyses. The results revealed no significant moderated mediation effect of personal distress (H4a, attitude toward seniors: index = 0.07, SE = 0.09, 95% CI [-0.11, 0.27]; H4b, participation intention: *index* = 0.01, *SE* = 0.05, 95% CI [-0.05, 0.14]; H4c, donation intention: *index* = -0.31, *SE* = 1.33, 95% CI [-3.39, 2.47]). In addition, we found no significant conditional indirect effect of temporal status on dependent variables through empathic concern, depending on the subject of the image (H5a, attitude toward the seniors: index = -0.01, SE = 0.06, 95% CI [-0.15, 0.12]; H5b, participation intention: index = -0.01, SE = 0.13, 95% CI [-0.25, 0.28]; H5c, donation intention: index = -0.08, SE = 1.14, 95% CI [-3.06, 1.89]). Therefore, H4 and H5 were not supported.

Post hoc test: Mediating effects of personal distress. To understand the role of personal distress based on the findings, we tested the mediating effect of personal distress in the relationship between temporal status and a) attitude toward seniors, b) participation intention, and c) donation intention, using PROCESS model 4. The results revealed the indirect effect of temporal status on attitude toward seniors through personal distress was significant (b = 0.13, SE = 0.25, 95% CI [0.05, 0.24]). Specifically, an age-morphed image (relative to a current image) was related to personal distress (b = 1.48, SE = 0.25, p < .001), and personal distress was negatively related to attitude toward seniors (b = -0.18, SE = 0.05, p < .05). The direct effect of temporal status on attitude toward seniors was insignificant (b = 0.27, SE = 0.17, p = .11), demonstrating that personal distress fully mediates the relationship between temporal distance and attitude toward seniors (see Fig. 1). The results indicated when people see an age-morphed image, they experience greater personal distress, which negatively affects their attitude toward seniors. However, the indirect effects of age-morphed images on participation intention (b = -0.05, SE = 0.10, 95% CI [-0.26, 0.16]) and donation intention (*b* = 1.18, *SE* = 3.07, 95% CI [-4.93, 7.49]) through personal distress were not significant.

2.3.5. Discussion

The analyses of Study 1 reveal that the effects of age-morphing technology and the role of emotional response could be limited, only supporting H1a. The results demonstrated that exposure to an agemorphed image, regardless of the subject of the image, can generate personal distress for college students, whereas we found no significant difference for empathic concern. Also, unlike the initial expectations, the results demonstrated that seeing age-morphed images of oneself did not lead to a significantly higher level of personal distress compared to





Fig. 1. Mediation effects of personal distress on attitude toward seniors (Study 1).

age-morphed images of another person. In addition, seeing an agemorphed image of another person did not lead to greater empathic concern than seeing an age-morphed image of oneself. One possible explanation for these nonsignificant findings may be that personal distress is the more self-focused emotional response that can be triggered with unpleasant and unwanted indications of aging (Batson et al., 1987), which implies the prominence of personal distress elicited by age-morphing images. Because college students are mentally and physically distant from aging, the age-progressed images, that are likely associated with negative impressions, might have primarily evoked the feelings of personal distress rather than those that concern others, that is, empathic concern. Thus, as the study showed, personal distress was generated among individuals exposed to age-morphed image, regardless of the subject of the image. The moderated mediation hypotheses (H4 and H5) were not supported, as there were no significant interaction effects of personal distress and empathic concern.

As the post hoc analysis revealed, the increased personal distress was negatively associated with people's attitude toward seniors. For college students, age-morphed images can elicit personal distress that negatively affects their attitude toward seniors. However, given that these results are initial findings and that the sample of Study 1 was college students who represent only a small subsection of millennials, an additional examination of these relationships must be executed using an extended sample of the population to verify the results and compare them across age groups.

2.4. Study 2: Online experiment with an extended population

The purpose of Study 2 was to examine the effects of age-morphed technology using an extended sample population that included a wider age range by reiterating hypothesis testing. We conducted Study 2 to investigate whether we could obtain the same results by using a larger general population including Millennials (ages 21–37) and Generation Xers (ages 38–52), testing the robustness of the initial results of Study 1. We wondered if the effects of temporal status and the subjects of the images were different for older age group.

2.4.1. Research design and participants

We conducted an online experiment on a sample of people who were aged between 21 and 52 and resided in the United States, using an online panel from Qualtrics. Participants were given monetary compensation (\$5) for their participation. We employed the same design of Study 1.

The sample size was 263, exceeding the sample size needed for the internal validity of the results (Hair, Black, Babin, Anderson, & Tatham, 1998). Of these, 140 (53.2%) participants were female, 211 (80.2%) were Caucasian, and 97 (36.9%) had a bachelor's degree. The mean age of the participants was 38 (SD = 8.34; see Table 1).

2.4.2. Stimuli and procedure

To conduct an online experiment, we used Change My Face (<u>changemyface.com</u>) for Study 2, which was more appropriate for an online experiment enabling participants to create and experience their own age-progressed images online without downloading and installing the software to their personal computers. This software also generated quality age-morphed images similar to AprilAge used in Study 1. We gave the participants a specific link and login information so they could experience their potential future appearance.

We randomly assigned each participant from two age groups to one of the four conditions (i.e., images of current self, current other, future self, and future other). For the current self condition, we asked participants to take a photograph of their current self by following the photo guidelines and upload it to Qualtrics as a response. For the future self condition, we asked participants to photograph themselves and follow a link to Change My Face. Subsequently, we asked them to create their age-progressed image, upload the screenshot of their age-morphed image to Qualtrics as a response, and take the time to view the image

Table 1

Demographic information for study 2 (n = 263).

Variables	Description	Frequency	Percent
Gender	Male	122	46.4%
	Female	140	53.2%
	Other	1	0.4%
Ethnicity	White/Caucasian	211	80.2%
	African American	16	6.1%
	Asian	21	8.0%
	American Indian/Alaska Native	1	0.4%
	Hispanic/Latino	11	4.2%
	Other	3	1.1%
Education	Some college completed	1	0.4%
	High school diploma or equivalency (GED)	25	9.5%
	Some college	28	10.6%
	Vocational degree/license	16	6.1%
	Bachelor's degree	97	36.9%
	Master's/Graduate degree	51	19.4%
	Doctorate degree	16	6.1%
	Professional (MD, JD, DDS)	29	11%
Average Age	$M = 38 \ (SD = 8.34)$		

before moving to the next section. For current other and future other conditions, we used the same stimuli from Study 1. We gave participants either an image of a stranger in his or her 20s or an age-progressed image of a stranger. In the beginning of the survey, to avoid gender bias, we asked participants to reveal their gender and then gave them an image that matched their gender for current other and future other conditions. In the following section, we asked participants to answer a questionnaire regarding their emotional responses and attitude toward seniors, as well as their behavioral intentions to support a senior-related campaign. To increase the robustness of the effects of the age-morphing technology, Study 2 included experiences with seniors as a control.

2.4.3. Measures

Past experience with seniors. Experience with certain people can positively influence the attitudes and behaviors regarding a group of people who share the same characteristics (Gerace, Day, Casey, & Mohr, 2015). We measured experience with seniors with Likert-type scale questions (1 = not at all, 7 = very much). We asked participants to indicate their experience of caring for, working with, and/or living with seniors throughout their lives.

2.4.4. Results

Main effects of temporal status. The results of ANCOVA revealed a significant main effect of age-progressed images on personal distress (H1a; *F* (1, 260) = 14.203, p < .001, $\eta_p^2 = .052$), as well as empathic concern (H1b; *F* (1, 260) = 16.063, p < .001, $\eta_p^2 = .058$). Participants who were exposed to an age-morphed image presented a higher level of personal distress (M = 4.18, SE = 0.16) than participants who saw a current image (M = 3.36, SE = 0.15), supporting H1a. However, contradicting the expectation, age-morphed images led to a lower level of empathic concern (M = 3.88, SE = 0.14) than current images did (M = 4.64, SE = 0.13), thus rejecting H1b. This result indicated that, for older people, a vivid age-progressed image could elicit a higher level of negative feelings, such as being upset, grief, and anxiety, compared to a current image. In addition, viewing the current image.

Interaction effects of temporal status and subjects of image on emotional responses. To test the interaction effects of temporal status and subjects of image on emotional responses (H2 and H3), we ran a series of ANCOVA. Consistent with the result of Study 1, we found no significant two-way interaction on personal distress (F(1, 258) = 2.532, p = .113, $\eta_p^2 = .01$). Thus, H2 was not supported. However, we found a significant two-way interaction of temporal status and subjects of image on empathic concern (F(1, 258) = 4.276, p < .05, $\eta_p^2 = .016$). The results of the pairwise comparison showed that people who saw an agemorphed image of another person (M = 4.42, SE = 0.19) displayed a

significantly higher empathic concern than people who saw an ageprogressed image of themselves (M = 3.34, SE = 0.19, $M_{differ} = 1.082$, F (1, 258) = 17.098, p < .001, $\eta^2_p = .062$; see Fig. 2). Thus, H3 was supported.

Moderated mediation effects of empathic concern. Using PRO-CESS model 7 (Haves, 2013), we conducted moderated mediation analyses to test H4 and H5 using a sample from the extended population. The subject of images (0 = self and 1 = other) and temporal status (0 = 1)current and 1 = future) were recoded for moderated mediation analyses. A series of analyses revealed no significant moderated mediation effects of personal distress, rejecting H4. There were significant moderated mediation effects of empathic concern on the relationship between temporal status and a) attitude toward seniors (H5a; index = 0.13, SE = 0.08, 95% CI [0.01, 0.31]; see Fig. 3), b) participation intention (H5b; index = 0.20, SE = 0.11, 95% CI [0.00, 0.44]; see Table 2), and c) donation intention (H5c; *index* = 5.23, *SE* = 2.91, 95% CI [0.24, 11.82]) depending on the subjects of image. The findings indicated that only when people saw an image of themselves, empathic concern mediated the relationships between temporal status and the dependent variables, whereas when they saw an image of another person, a mediation effect did not subsist. That is, the conditional indirect effects of temporal status on dependent variables (i.e., attitude, behavioral intention, and donation intention) were significant through empathic concern, only under conditions relating to the image of self. Specifically, an image of the current self led to greater empathic concern (compared to an image of future self), eliciting more favorable attitude and support intentions. Contrary to expectations, the moderated mediation effects of empathic concern emerged when the image was about self, not about other, thus rejecting H5.

Post hoc test: Mediating effects of personal distress and empathic concern. Controlling for experiences with seniors, we tested the mediating effects of personal distress using Hayes PROCESS, model 4. The results revealed that the findings were inconsistent with Study 1, showing that personal distress positively mediated the relationships between temporal status and participation intention (b = 0.057, SE =0.04, 95% CI [0.00, 0.12]) and donation intention (*b* = 2.46, *SE* = 1.11, 95% CI [0.60, 4.86]), except for attitude toward seniors (b = 0.01, SE =0.03, 95% CI [-0.05, 0.07]). Specifically, the full mediation effects of personal distress on the relationship was found between temporal status and participation intention. Temporal status was associated with personal distress (b = .82, SE = 0.22, p < .001) and higher levels of personal distress were associated with participation intention (b = 0.08, SE =0.04, p < .05), whereas temporal status' direct effect on participation intention became insignificant (b = -0.07, SE = 0.14, p = .62). Even though it was unexpected, according to the results relating to H1b, a





Fig. 2. The results of interaction effects of temporal status and subject of images on empathic concern (Study 2).





Fig. 3. Moderated mediation effects of empathic concern on attitude toward seniors (Image of self conditions: b = -0.20, SE = 0.07, 95% CI [-0.37, -0.08], image of other conditions: b = -0.07, SE = 0.05, 95% CI [-0.17, 0.02]; Study II).

Table 2

Results of the Moderated Mediation Analysis of Empathic Concern on Participation Intention (Hayes PROCESS, model 7).

		Mediating variable model (empathic concern)				
Predictor variables ($R^2 = .23, p < .001$)		b	SE	t	р	
Constant		2.80	.31	8.97	.000	
Temporal status		-1.14	.26	-4.44	.000	
Subject of image	.32	.26	1.25	.21		
Interaction: temporal \times	.76	.37	2.08	.04		
Past experience with se	.32	.05	6.29	.000		
		Dependent variable model (attitude toward seniors)				
Predictor variables (R ²	b	SE	t	р		
Constant	3.18	.25	12.97	.000		
Temporal status	.19	.14	1.39	.165		
Empathic concern	.26	.04	5.97	.000		
Past experience with seniors		.19	.04	4.95	.000	
Conditional indirect effects						
Mediator	Moderating varia	able	b	SE	Boot 95% CI	
Empathic Concern	Self (0)		30	.09	[50,14]	
Empathic Concern	Other (1)		10	.07	[24, .03]	

current image led to significantly less empathic concern. Therefore, we also conducted the mediating effect tests for empathic concern. The results revealed that empathic concern negatively mediated the relationships between temporal status and on attitude toward seniors (b = -0.13, SE = 0.05, 95% CI [-0.24, -0.05]), participation intention (b = -0.20, SE = 0.06, 95% CI [-0.33, -0.09]) and donation intention (b = -5.29, SE = 1.69, 95% CI [-8.98, -2.28]). More specifically, temporal status was negatively related to empathic concern (b = -0.76, SE = 0.19, p < .001), and empathic concern led to greater favorable attitude (b = 0.17, SE = 0.04, p < .001). These results indicated that for a wider and older population, an age-morphed image can lead to less empathic concern (compared to an image of the current appearance), negatively affecting outcomes.

2.4.5. Discussion

Whereas Study 1, which we administered to college students, revealed limited significant findings that support the hypotheses, Study 2 revealed additional significant findings related to the role of empathic concern among the extended population. First, consistent with the findings of Study 1, the results of Study 2 show that age-morphed images can lead to a higher level of personal distress for a larger and older population. In addition, as hypothesized, Study 2 shows that seeing an age-morphed image of others leads to greater empathic concern than seeing an image of age-morphed self. However, the support for the

explanation is limited because the counterpart is not significant. That is, considering that an age-morphed image of self did not lead to greater personal distress than an age-morphed image of others, perspective-taking remained as a limited explanation for the effects of age-morphed images.

Furthermore, significant moderated mediation effects of empathic concern exist, implying that emotional responses can play a critical role in promoting favorable attitudes toward and actions for seniors. The results show two unexpected but interesting findings: a) The moderated mediation effects of empathic concern occur only under the image of self conditions rather than the image of other conditions and b) agemorphed images generate a lower level of empathic concern than images of current appearance. Only when the image is of self, the current image elicits greater empathic concern (than the age-morphed image), leading to more favorable attitudes and supportive intentions toward seniors. These results indicate that the age-morphed images cannot guarantee to facilitate perspective-taking for the general population and subsequent sympathetic affects and behaviors. In addition, the findings demonstrate that the subject of the image is a critical factor for understanding the potential effects of age-morphing technology on specific emotional responses and using them to maximize favorable communicative goals. One possible explanation for this is that participants, particularly those who are older in a group, might feel greater warmth and compassion toward the current image of themselves that they feel is more present and imminent, than toward a potential appearance in the future. For the older population, age-morphed images can be less effective in creating empathic concern for the subject of the images, compared to the images that show current appearance.

Another interesting finding of Study 2 was that the role of personal distress differs from the results of Study 1. The post hoc test revealed positive mediating effects of personal distress. That is, the heightened personal distress subsequently leads to greater participation and donation intentions among the extended population. These results indicated that, whereas personal distress as a response to age-morphed images as negatively associated with attitude toward seniors and a lower level of participation intentions to address senior-related issues (negative mediation) for college students, personal distress leads to positive attitude and more supportive intentions for the older and wider population (positive mediation). These results indicate that age groups could display different reactions (i.e., attitudinal and behavioral outcomes) to certain emotional responses generated by seeing an age-morphed image.

3. General discussion

With the growth of senior population and the reality of an aging society, reducing people's negative attitudes toward and facilitating behaviors that help seniors is imperative. The primary goal of this research was to examine the affective effects of vivid, age-progressed images on people's attitude toward and supportive intentions for seniors. The results of the two studies lend support to the idea that the effects of temporal status manipulated by age-morphing technology and subjects can elicit specific emotional responses—personal distress and empathic concern—and that these emotional responses can influence people's attitudes toward and supportive behaviors for seniors. These results contribute to the academic field of communication, as well as have important practical implications of the effects of age-morphed images as a communication campaign tool.

3.1. Theoretical implications

The findings expanded the literature of the affective effects of futurerelated technology, particularly age-morphing technology, on promoting individuals' positive attitude toward seniors and behavioral intentions to support seniors. In this research, we have attempted to advance our knowledge of the effects of the age-morphing technology by examining the role of emotional responses grounded in the perspectivetaking framework. According the research on perspective-taking and emotional responses, personal distress can serve as either a negative or positive mediator to promote favorable outcomes (Maner et al., 2002). Study 1 reveals that, in accordance with the findings of Rittenour and Cohen (2016), a visual experience of one's potential future appearance leads to personal distress that negatively affects attitude toward seniors among university students. However, Study 2 shows a positive mediation of personal distress on the relationship between temporal status and supportive intentions (i.e., participation and donation intentions) more specifically among the Millennial population. That is, when college students see age-morphed images, they can feel distress that negatively influences their attitude toward seniors. However, for an extended population that includes Millennials as well as Generation X, the increased personal distress they experience because of age-morphed images can lead to a higher level of supportive intentions for seniors. These results imply that personal distress can serve as a mediator that generates either negative or positive results across generations, consistent with the previous literature. This also highlights the potential varying effects of emotional responses on promoting favorable attitudes and supportive intentions across different age groups, which could partially be attributed to the general difference in types of psychological distress and coping strategies between the younger and older generations (Folkman, Lazarus, Pimley, & Novacek, 1987; Jorm et al., 2005). This research contributed to advancing our understanding of the potential effects of age-group differences on persuasion process using age-morphing technology by using a wide range of age groups, which fills the void from previous research on age-morphing technology focused only on young people as subjects of testing (Lee, 2017; Oh et al., 2016).

Empathic concern showed consistent effects that lead to favorable attitude and behavioral intentions related to seniors. However, we only found significant results in Study 2, which reveal the moderated mediation effects of empathic concern on the relationship between temporal status and dependent variables (i.e., attitude toward seniors and participation and donation intention for seniors) when the image was only about self rather than others. In addition, seeing an age-morphed image of oneself leads to a lower level of empathic concern compared to an image of current self. One of the likely reasons for these findings is that it might be easier for older people to connect to their current selfimage and feel more compassionate toward their current appearance than toward age-morphed images, which, on the contrary, fail to elicit more sympathetic feelings. Considering the consistent pattern that current images generated greater empathic concern compared to agemorphed images from Study 1 and 2, it is possible that just an image of the other person would not lead to greater empathic concern, which does not provide any reason to be compassionate or sympathetic about. The positive associations of empathy with favorable attitude toward and supportive intentions for seniors highlight that it is pivotal to understand 1) what caused people's greater sympathetic and compassionate feelings for their current image rather than for the image of their potential future appearance and 2) which subject could generate greater empathic concern from college students and the larger population. These results collectively provide limited support for several hypotheses, but still demonstrate the potential critical role of emotional responses in maximizing favorable effects of age-morphing technology.

In addition, we investigated new approaches to perspective-taking processes by employing virtual technology that can facilitate the process. Previous research in perspective-taking has used the traditional means of imagination–response procedures to test perspective-taking and emotional responses (Batson et al., 1983, 1987; Cialdini et al., 1987; Cristea et al., 2014). This research used age-morphing technology that provides people an opportunity to experience visually a potential future life as an older person rather than imagining it. This virtually aided manner of perspective-taking can be a critical and prominent method that can promote perspective-taking processes to reduce negative stereotypes of other social groups (Yee & Bailenson, 2006). This

research contributed to advancing our knowledge of how new future-related technologies can influence perspective-taking procedures and people's emotional responses that affect attitudes and behavioral intentions.

In addition, these studies expanded the literature of aging simulation by employing a general population rather than specific groups. Previous research that focused on how to reduce ageism demonstrated the positive effect of simulated aging programs on attitude toward seniors (Yu & Chen, 2012). Simulated aging activities that allow people to experience the daily challenges of seniors (e.g., experiencing failing eyesight by wearing thick glasses covered with petroleum jelly) and sensory loss activities facilitated empathy for and positive attitudes toward seniors (Green & Dorr, 2016; Yu & Chen, 2012). However, those studies were limited to participants from medical- and nursing-related majors or professionals. Those students took a training or a program that allowed them to experience physical deficits through several tasks for a substantial period (e.g., 4-week or 6-week program). Such trainings or programs are often neither accessible nor feasible for the general population. Virtual experience using age-morphing technologies can be an alternative for promoting a favorable attitude toward the seniors and supportive intentions among the general population.

3.2. Practical implications

These studies provide critical practical implications by examining the underlying mechanisms of the effects of age-morphed images and exploring the technology's advantage as a communication tool for senior-related campaigns or programs. Because of the technology's unique ability to provide vivid and affordable visual future experience, it can be applied in myriad ways to promote a favorable attitude and helping behavior toward seniors. For example, organizations such as the American Association of Retired Persons (AARP) and the Alzheimer's Association can use the technology as a part of their social media campaigns to promote volunteering for and donating to seniors. The results of the study demonstrated that experiencing age-progressed images through technology could generate certain emotional responses that can elicit helping behaviors for seniors among college students, Millennials, and Generation Xers. The findings of the empirical studies highlighted the varying results of personal distress on favorable attitudes and behaviors across different age groups. Therefore, communication strategies employing the technology should be tailored to the target population to generate the most favorable outcomes for senior-related campaigns. Considering that age-morphing technology has gained attention and many people across the globe have demonstrated an interest in checking and posting their age-progressed images on their social networking sites (Haselton, 2019), these results can help communication practitioners create strategies that are fittingly targeted and effective for specific generations to use the technology helpfully to solve issues relating to seniors.

4. Limitations and future directions

The current study had several limitations. First, the sample of Study 1 is imbalanced in terms of gender (i.e., 81.6% were female, whereas 18.4% were male). Even though overpresentation of female in undergraduate research pool is practically not uncommon, gender imbalance in study using small-size samples can raise concerns for their representativeness (Dickinson, Adelson, & Owen, 2012). The current results of Study 1 might be limited due to this gender imbalance in the sample. Future research should attempt to obtain a balanced sample to achieve more representative results for young population. Second, seemingly contradictory results emerged regarding the mediating effects of personal distress, with negative mediation in Study 1 and positive mediation in Study 2. Age-group effects, as well as the ease and type of helping behaviors, may explain these results. Some scholars have revealed that, when personal distress superseded empathic concern, helping behavior reduced (Carrera et al., 2013). For people with egoistic motives for helping, helping is unlikely to occur when the cost of helping is high and avoidance is easy, whereas people with altruistic motives still choose to help rather than avoid, when facing the same situation (Batson et al., 1981). Furthermore, some researchers have found that personal distress enhances moral disengagement, which facilitates self-centered behaviors (Paciello et al., 2013). These findings imply a relatively weak association between personal distress and prosocial behaviors, which do not guarantee subsequent helping behaviors, depending on which actions people are asked to perform, compared to the connection between empathic concern and helping behaviors. Therefore, future research should include various helping behaviors for seniors that have different levels of ease of avoiding to advance our understanding of the complicated effects of personal distress on favorable outcomes.

Additionally, the limited findings of the effects of age-morphed images can be attributed to the fact that mere exposure to age-morphed images might not be sufficient to generate significant results, such as a positive attitude toward and supportive intentions to help seniors. Previous research has revealed that the frequency and quality of interaction with seniors are critical contributors for promoting favorable attitudes toward seniors (Tam et al., 2006). This research tested only the effects of a one-time exposure to age-progressed images, which might be limited for eliciting consistent and significant findings of the technology's effect. Therefore, future research is needed to examine further the effects of the frequency or quantity of exposure to age-morphed images on outcome variables by conducting longitudinal studies.

Furthermore, Study 1 and Study 2 used different age-morphing software and, accordingly, different procedures. First, the AprilAge software (in Study 1) required us to formulate age-progressed images of participants using current photos of them, which we obtained in advance. Whereas the quality of the age-morphed images, to some extent, hinged on our ability to use the software (Study 1), the Change My Face software provided consistent age-morphed images with automatic progression (Study 2). This might explain the different results. Also, the quality of the participants' photos used for both age-morphing software is critical to production of realistic age-morphed images. In future research, participants' perception of the quality of their agemorphed images should be considered as a control variable, which we did not measure in the current study. Furthermore, participants of Study 1 were asked to answer the questionnaire immediately after they saw the age-morphed image created with their photo they submitted in advance. In other words, Study 1 did not require the participants to use agemorphing software. However, in Study 2, participants were asked to take a picture of themselves by using the camera on their electronic devices (i.e., mobile phones and laptops), click a website link, login to age-morphing software using the provided ID and password, upload the photo to the system to check their potential future appearance, and upload a screenshot of their age-morphed image to Qualtrics as an answer. This procedure possibly required substantial effort to complete the task, leading to mental fatigue and resulting in a large number of dropouts. The results we obtained from the people who completed the tasks could be biased. Whereas a more engaging process enriches the experience and provides greater immersion, we might attribute stronger results from the age-morphed conditions to its more engaging process.

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Appendix

Examples of age-morphed images using AprilAge software.

Age 32

Age 72 with natural aging



Author contributions

Ah Ram Lee: Conceived and designed the analysis, Collected the data, Contributed data or analysis tools, Performed the analysis, Wrote the paper. Eunice Kim: Wrote the paper. Linda Hon: Conceived and designed the analysis, Wrote the paper. Yoo Jin Chung: Collected the data.

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