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Article

The Moderating Role of Age in the Effect of Video Playback Speed on Urgency Perception in the Context of Climate Change

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Abstract: Urgency perception plays a vital role in addressing the issue of climate change. However, little is known about how to promote the perceived urgency of climate change and its potential influence on proenvironmental intention and behavior. This research focuses on a potentially significant but less studied factor in video communication: video playback speed. The current research explores the effectiveness of video playback speed as a subtle behavioral nudge to influence urgency perception and proenvironmental response in the context of climate change. We conducted two survey-embedded experiments in which participants watched a climate change video playing at either normal or fast speed and then completed measurements. Data were collected first in an undergraduate sample ($n = 75$) and then in a general population sample ($n = 300$) and analyzed using Mann–Whitney U tests, chi-squared tests, and moderation analysis in SPSS. The results reveal that a fast playback speed of climate change video decreases the perceived urgency of climate change for younger consumers, not for older consumers. However, video playback speed does not influence proenvironmental intention and behavior. These findings enhance understanding of when video playback speed affects urgency perception and proenvironmental tendency, and provide valuable insights for climate change communication.

Keywords: video playback speed; climate change urgency perception; proenvironmental behavior; behavioral nudge



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1. Introduction

“There is one issue that will define the contours of this century more dramatically than any other, and that is the urgent threat of a changing climate.”

—Barack Obama

Climate change is one of the biggest challenges that needs to be classified as a top priority in our times. The idea of climate change as an “urgent” issue was put forward years ago and garners increased attention under the context of international documents such as the Intergovernmental Panel on Climate Change [1] and Sustainable Development Goal on climate action [2]. Accordingly, major press outlets such as BBS News have framed climate change issues as part of a “global emergency” [3].

Despite the international protocols and mass media perspectives about climate change urgency, little is known about how individuals perceive a sense of urgency related to climate change through those communications. Moreover, marketers and policymakers have not yet identified the most effective ways to raise consumers’ urgency perception of climate change risks. This question is relevant because a sense of climate change urgency has great potential to drive proenvironmental behavioral change [4].

The present research focuses on *video playback speed*—a content-irrelevant feature in climate video communication. Sped-up videos have been utilized to create a special atmosphere, such as a fast pace [5] and emotions of high arousal [6]. For example, Apple’s

2016 iPhone launch ad “Don’t Blink” was a fast-paced commercial clip with words flashing at a compact pace, which conveyed a sense of excitement [7]. However, video playback speed remains a niche in marketing practice and academic research. Playback speed should receive more attention and be thoroughly investigated as an easily manipulated element in video marketing. Especially regarding climate change video communication, more research examining the effect of video playback speed on perception and behavior is required.

Two key questions herein drive our exploration. First, does playback speed influence a sense of climate change urgency communicated through video stimuli and change subsequent proenvironmental intention and proenvironmental behavior? Second, do consumer characteristics (e.g., age) moderate the effect?

To evaluate the influence of video playback speed on climate change urgency communication, we designed two survey-embedded experiments where participants watched a climate change video played at either normal or fast speed and then completed measurements of proenvironmental intention, proenvironmental behavior, and climate change urgency perception. Following a pilot study that examined the main effects of video playback speed on outcomes in a sample of younger consumers, we looked at the moderating role of consumers’ age in the main study.

The article contributes to the limited literature with regard to research on consumer perceptions of video stimuli with various playback speeds. To our knowledge, the current study is the first one pioneering the manipulation of video playback speed in the context of climate change risk communication. Second, we enrich the proenvironmental literature by introducing a neglected but influential characteristic of proenvironmental video stimuli (i.e., playback speed). Third, our research contributes to the emerging literature on climate change urgency by redefining and measuring the concept of climate change urgency perception, quantifying its attitudinal and behavioral outcomes, and examining video playback speed as an antecedent factor. Fourth, we provide evidence for the elaboration likelihood model and the elaboration deficit hypothesis by demonstrating the differential effects of playback speed on urgency perception for different age groups. Moreover, our conclusions also offer important implications for climate change communication that would be relevant for policymakers and marketers.

The remainder of this paper is organized as follows: Section 2 reviews the relevant literature and puts forward the hypotheses; Sections 3 and 4 provide the methodology and results of two experimental studies; and Section 5 discusses the main results, theoretical contributions, practical implications, limitations, and further directions.

2. Theoretical Background

2.1. Video at a Fast Playback Speed

Fast playback speed video refers to videos in which playback or framerate is sped-up so that the objects appear to be moving more quickly than normal. Moreover, the audio is accelerated simultaneously with almost no audio pitch distortion. As techniques have been improved, researchers have found ways to increase the auditory rate without affecting its quality [8]. This allows fast-speed playback while retaining high-fidelity audio, the original pitch, and synchronization with the video. Notably, the application of fast playback is distinct from fast forward or video summarization, which eliminates audio simultaneously [9].

In video advertising, marketers have used fast playback speed video or audio for instrumental reasons, such as saving advertisement costs [10] and creating a fast-paced atmosphere [5]. In addition to commercials, sped-up video is also studied in sports [11,12], education [13–16], and clinical research [17]. More recently, fast playback speed videos have become popular on social media and live streaming platforms, partly because fast-playback options are accessible and built-in functions on most video apps (e.g., TikTok, YouTube, and iQIYI); this allows users to choose playback speed that is faster than the original video over a wider range (e.g., $\times 1.25$, $\times 1.5$, $\times 1.75$, $\times 2$).

Prior research has documented various sped-up video effects (see Table 1), many of which are about the impacts on human perception and subsequent behavior. Some studies focus on perceptions of a specific target, e.g., products, ads, or the human body. For example, several marketing studies have examined how products displayed at a fast speed rather than a regular speed influence consumers' perception of product size [18], product evaluation [19], or preference for ads with different construal levels [20]. Herbst and colleagues [21] found that a fast running speed of end-of-advertisement disclaimers reduces consumers' purchase intention through the perceived credibility of the ad. Concerning the effect of the moving speed of the human body on perception, Fink and colleagues [22] examined how walking speed (manipulated by playback speed) affects strength perception and level of attractiveness, and Malik and Sayin [23] explored how hand movement speed affects perception of masculine characteristics. In addition, a few studies explored how speeding up natural scenes may influence people's general perception of time [24,25].

Table 1. Literature review on the effect of fast video speed (or motion speed) on human perception and behavior.

Study	Context/Stimuli	Key Findings
Grivel et al. [24]	Natural scenes of a crowded street	People's sense of time was dependent on the speed of their visual environment.
Herbst et al. [21]	End-of-advertisement disclaimers	Fast (vs. normal-paced) end-of-advertisement disclaimers were perceived as less credible, which incurred less purchase intention.
Nyman et al. [25]	Natural scenes of an indoor market space	Video playback speed did not predict peoples' time estimates.
Fink et al. [22]	Walking speed perception	Strength perceptions and attractiveness ratings of walkers did not differ between the fast speed and the normal-speed condition.
Jia et al. [18]	Product advertising (e.g., audio speaker)	Consumers estimated the size of an immobile product to be smaller when it was animated to move faster in videos.
Yoon et al. [20] (Study 3 and 4)	Product advertising (Nikon cameras)	When TV commercials played slowly (rapidly), consumers preferred high-construal (low-construal) advertising appeals that emphasized quality (price).
Malik and Sayin [23] (Study 1B)	Hand movement speed perception	People implicitly associated speedy movements with a more masculine (than feminine) behavior.
Yin et al. [19] (Study 6)	Product advertising (Nature's Essence face wash)	Playing a commercial at fast speed (vs. natural speed) led to a marginally more negative product evaluation and greater visual difficulty. The effect of fast speed might be explained by lower perceived amounts of information that were induced by greater difficulty in visual processing.
Present research	Climate change urgency	Fast playback speed led to lower perceived urgency of climate change for younger consumers compared to normal playback speed.

In the present research, we target the video playback speed effects on consumers' sense of urgency in the context of climate change. This research would shed light on how elements in audio–visual materials would influence a viewer's cognitive perception of speed.

2.2. Video Playback Speed and Climate Change Urgency Perception

Perceived urgency refers to subjective experience associated with the belief that delays or deprioritization will increase expected costs or decrease expected benefits [26]. The concept of urgency is also related to the psychological distance in climate change risk perception, which describes how individuals perceive an event to be psychologically proximal or distal to themselves [27]. Remarkably, urgency perception is proposed as the temporal dimension of psychological distance [28–30]. This article proposes climate change urgency perception as both a sense of proximity for immediate (usually negative) consequences of climate change risks and an imperative need or requirement for actions (e.g., mitigation and adaptation efforts). As climate change becomes a severe global problem, the perceived urgency of climate consequences and actions become much more pivotal but understudied.

Besides content in video marketing, peripheral cues such as video speed may also communicate urgency. One intuition is that accelerating the video materials may contribute to a sense of urgency in light of the stimulus–organism–response perspective. Several studies indicate that an accelerated speech rate increases the perceived urgency [31], a fast tempo increases the perceived urgency of auditory stimuli [32,33], and a fast playback speed elicits emotions of high arousal, such as urgency [32,34].

However, other research suggests that fast speed may reduce persuasion. According to the elaboration likelihood model (ELM) [35], fast speech can limit people’s ability to process or elaborate on message content; thus, its effect on persuasion depends on whether such processing would have had positive or negative effects. If elaboration would have yielded greater persuasion, as when argument quality is strong, then fast speech hinders persuasion [36]. If elaboration would have yielded weaker persuasion, in contrast, then fast speech promotes persuasion. Specifically, since time to process information is limited when visual stimuli are sped up, we argue that consumers have less ability to thoughtfully consider the communicating messages in the videos, that is, less attentive focusing on the messages (i.e., low elaboration), compared to videos at a normal speed (high elaboration) [37,38]. Therefore, for video materials communicating climate change risks, the fast playback speed (i.e., low elaboration) may inhibit the information processing, leading to less formation of urgency perception.

Considering these mixed findings in the literature, the primary purpose of the current research is to explore how video playback speed might influence consumers’ urgency perception of climate change and proenvironmental response.

2.3. The Moderating Role of Age in the Effect of Video Playback Speed on Climate Change Urgency Perception

Older people will engage in lower levels of cognitive elaboration [39–41]. According to the elaboration deficit hypothesis, older adults are less likely than young adults to construct or activate a network of semantic relationships when presented with material to be recalled and are therefore less likely to retain information [42].

Need for cognition (NFC), defined as “the tendency for an individual to engage in and enjoy thinking”, is one determinant of consumers’ motivation to process information [43]. Consumers with a high need for cognition take the central route in attitude change, whereas consumers with a low need for cognition tend to adopt the peripheral route in forming attitudes [44].

Younger consumers have more capability for elaboration, which leads to more attention to the central argument: the climate change urgency information in the video. Therefore, younger consumers will perceive less urgency of climate change after watching the fast-speed video, which is detrimental to information-understanding compared to the normal-speed video. On the other hand, older consumers tend to engage in less elaboration, which results in more heuristic processing [45] and more reliance on peripheral cues such as video playback speed. Therefore, older consumers may perceive a higher urgency of climate change in the fast-speed video condition than in the normal-speed video condition.

Based on the elaboration likelihood model (ELM), we suggest that the effect of video playback speed on climate change urgency perception will be moderated by age, and we propose the following hypotheses:

Hypothesis 1 (H1). *Age will moderate the effect of video playback speed on climate change urgency perception.*

Hypothesis 1a (H1a). *For younger consumers, a fast playback speed will impair climate change urgency perception compared to a normal playback speed.*

Hypothesis 1b (H1b). *For older consumers, a fast playback speed will enhance climate change urgency perception compared to a normal playback speed.*

2.4. Downstream Effects on ProEnvironmental Intention and Behavior

We also explored the potential downstream effects of video playback speed on pro-environmental intention and behavior. Recent research suggests that framing climate change as urgent can serve to promote proenvironmental intention and actual behavior [46]. In addition, research shows that perception of global climate change [47] can influence private-sphere proenvironmental behavior [48–51]. However, the effects of urgency perception on proenvironmental responses are mixed [26,28,52]. For example, recent research shows that perceived urgency is vital in driving support for “low-cost” mitigation policies but not “high-cost” mitigation ones [28]. Therefore, we suggest that the playback-induced climate change urgency perception has the potential to impact subsequent proenvironmental intention and behavior.

Based on this line of research, we hypothesize that video playback speed will also influence proenvironmental intention and behavior. Similar to hypothesis 1, we propose that age will moderate the relationship between video playback speed and proenvironmental intention and behavior. To summarize:

Hypothesis 2 (H2). *Age will moderate the effect of video playback speed on proenvironmental intention.*

Hypothesis 2a (H2a). *For younger consumers, a fast playback speed will impair proenvironmental intention compared to a normal playback speed.*

Hypothesis 2b (H2b). *For older consumers, a fast playback speed will enhance proenvironmental intention compared to a normal playback speed.*

Hypothesis 3 (H3). *Age will moderate the effect of video playback speed on proenvironmental behavior.*

Hypothesis 3a (H3a). *For younger consumers, a fast playback speed will impair proenvironmental behavior compared to a normal playback speed.*

Hypothesis 3b (H3b). *For older consumers, a fast playback speed will enhance proenvironmental behavior compared to a normal playback speed.*

The proposed hypotheses are summarized in the conceptual model in Figure 1.

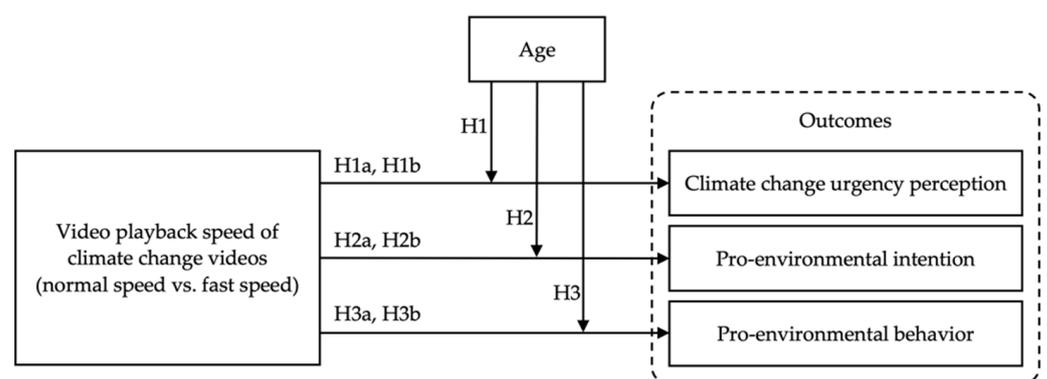


Figure 1. Conceptual model.

3. Pilot Study

We undertook a pilot study prior to the main study to (a) preliminarily test hypotheses for the effect of video playback speed on climate change urgency perception and pro-environmental responses in a convenient student sample (i.e., younger consumers); and (b) examine the reliability of the self-developed scale of climate change urgency perception.

3.1. Method

3.1.1. Procedure, Participants, and Design

Design and participants. The study employed a single-factor, two-level design, with the running speed of the video serving as a between-subjects factor (normal speed vs. fast speed). Participants were undergraduates from a university in southeastern China. They were asked to complete an online survey in exchange for partial course credit. A total of 83 undergraduate students took part in this experiment and were randomly assigned to the normal-speed video condition ($n = 42$) or the fast-speed video condition ($n = 41$) using the Randomizer function in the online questionnaire (Qualtrics). Of those, eight failed an attention check question (e.g., responded incorrectly to the following instructions: “Please choose the number 4”) [53] or factual questions about video contents. Thus, the final sample comprised 75 participants (60% female; age in years: $range = 19–31$, $M = 21.43$, $SD = 1.57$), with 39 participants ($M_{age} = 21.28$, $SD = 1.89$) in the normal-speed video condition and 36 participants ($M_{age} = 21.58$, $SD = 1.16$) in the fast-speed video condition. Preliminary analyses revealed no significant differences between the two playback-speed conditions in terms of gender distribution ($\chi^2 = 0.04$, $p = 0.850$), age ($t = -0.82$, $p = 0.413$), or income ($t = 0.34$, $p = 0.737$), indicating that randomization was successful for these demographic variables. Additional analyses involving the eight excluded participants produced virtually identical results.

Video stimuli. We used a 22 s promotional video clip from the WeChat channel that calls for sustainable lifestyles. The scenes depicted melting glaciers and walking penguins, with titles and captions appearing at the top and bottom. The title read, “the North and South Poles reached a high temperature of 40 degrees Celsius above normal”, accompanied by sequentially appearing captions that deliver climate crisis messages and call for imminent environmental protection. The original video featured tense background music as its only sound. Due to the high playback speed of the original video clip, we decelerated it to 37 s for the normal-speed condition and retained the initial 22 s for the fast-speed condition (video posted on OSF: <https://bit.ly/3z4VFUy>, accessed on 31 May 2022).

Experimental procedure. Before the experiment, participants were told to turn on the device’s sound to ensure that they could hear the audio of the video. In the first part of the questionnaire, participants watched a video clip of either normal speed or fast speed, to which participants were randomly assigned. After the video exposure, participants answered three factual questions about the video contents. Then, they were led to a seemingly unrelated survey that measured three core dependent variables: proenvironmental intention, proenvironmental behavior, and climate change urgency perception. We inquired about participants’ age, gender, and income at the end of the survey. Finally, participants were debriefed and thanked.

3.1.2. Measures

Proenvironmental intention. A choice scenario adapted from Du et al. [54] was used to measure the purchase intention of green products. Participants were shown two outdoor backpacks from the same brand—Super Strength backpack S and Eco-friendly backpack E—which were the same size and price, but differed in materials, craftsmanship, and styles. The characteristics of *backpack S* were “it is made of light, tough, wear-resistant and waterproof high-density nylon fabric and super-strong zinc alloy resin zipper, with fine workmanship; Multitier warehouse to accommodate more items, super storage space; Unique color frame design, beautiful appearance, free fashion.” The characteristics of *backpack E* were “it is made of sustainable materials such as organic fiber and recycled materials such as recycled polyester; Minimize waste generation and toxic substances emission during manufacturing, and minimize the consumption of natural resources; It can be recycled and returned to nature safely when scrapped”. Participants were asked to indicate their preference between the two outdoor backpacks on a unipolar 7-point scale (“If you had a choice between the Super Strength backpack S and the Eco-friendly backpack E, which would you be more likely to choose?”; 1 = *definitely choose backpack S*, 4 = *neutral*,

7 = *definitely choose backpack E*) ($M = 3.47$, $SD = 1.60$). Participants with a higher score were considered to exhibit a higher level of proenvironmental intention.

Proenvironmental behavior. Participants were told that the experimenters plan to work with the university's energy conservation and emission-reduction association to launch an initiative designed to reduce one's personal carbon footprint and included clarifying the understanding of personal impact on the environment and climate, assessing personal carbon emissions in daily life, and continuously practicing low-carbon behaviors to respond to global environmental issues such as climate change. We told the participants that we were recruiting volunteers and asked whether they would like to participate in this initiative. If participants were willing to support this environmental initiative, they needed to provide their email to receive a registration form. In contrast, if they had no interest, they could ignore this question. The answer to this question was coded as 0 (not leaving an email) and 1 (leaving an email). We used the option of offering an email as a proxy for actual proenvironmental behavior, as in prior studies [55,56].

Climate change urgency perception. Due to limited relevant measurements in climate change urgency literature, we referred to [26,28] for item development, focusing on both proximal characteristics of the issue and the need for action. Participants indicated their perceived urgency of climate change by responding to four items: "Climate change isn't a distant threat—it's happening NOW", "Climate change is an imminent threat for human beings", "Climate change requires immediate action", "We must act NOW to stop climate change". All items were measured on a 7-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *somewhat disagree*, 4 = *neither agree nor disagree*, 5 = *somewhat agree*, 6 = *agree*, 7 = *strongly agree*). Scale reliability was good ($\alpha = 0.88$), so we computed a mean score for these items ($M = 5.94$, $SD = 1.09$).

Demographic information. Age was measured by asking participants to report their age in years. Gender was measured as a dichotomous variable, which was dummy-coded (1 = male; 2 = female) in the statistical analysis. Income was measured by the individual's annual household income (in Chinese RMB), which was dummy-coded into twelve categories (1 = Less than RMB 50,000; 2 = RMB 50,000–100,000; 3 = RMB 100,000–150,000; 4 = RMB 150,000–200,000; 5 = RMB 200,000–250,000; 6 = RMB 250,000–300,000; 7 = RMB 300,000–350,000; 8 = RMB 350,000–400,000; 9 = RMB 400,000–450,000; 10 = RMB 450,000–500,000; 11 = RMB 500,000–750,000; 12 = More than RMB 750,000).

3.1.3. Data Analysis

Data were analyzed with the Statistical Package for the Social Sciences (SPSS) version 26. The Kolmogorov–Smirnov (K–S) test indicated that data of the climate change urgency perception construct did not follow a normal distribution ($p < 0.05$). Thus, a Mann–Whitney U test was conducted to assess the differences in climate change urgency perception between the normal-speed condition and the fast-speed condition (H1a). Likewise, due to the non-normality of the data associated with the proenvironmental intention (K–S, $p < 0.05$), a Mann–Whitney U test was used for the comparison of the distribution of proenvironmental intention between the two playback-speed conditions (H2a). Moreover, a chi-squared test was carried out to examine whether video playback speed had an effect on proenvironmental behavior (H3a).

3.2. Results

Climate change urgency perception. The Mann–Whitney U test identified that there were significant differences based on video playback speed for the climate change urgency perception ($U = 469.50$, $Z = -2.49$, $p = 0.013$, $d = 0.594$). Specifically, participants in the fast-speed condition ($M_{\text{fast}} = 5.59$, $SD = 1.28$) reported lower climate change urgency perception than those in the normal-speed condition ($M_{\text{normal}} = 6.27$, $SD = 0.75$). The result thus supported H1a that a fast playback speed diminishes younger consumers' perceived urgency of climate change compared to a normal playback speed.

Proenvironmental intention. The Mann–Whitney U test revealed that there was no significant difference between two conditions for the proenvironmental intention ($U = 656.00$, $Z = -0.50$, $p = 0.620$; $M_{\text{normal}} = 3.54$, $SD = 1.57$; $M_{\text{fast}} = 3.39$, $SD = 1.64$). Therefore, H2a was not supported.

Proenvironmental behavior. The chi-squared test revealed no significant main effect for proenvironmental behavior, $\chi^2 = 0.52$, $p = 0.472$. Specifically, the rate of leaving one's email was 30.56% for the fast-speed condition, while 38.46% for the normal-speed condition. Therefore, H3a was not supported.

4. Main Study

The pilot study relied on a relatively young consumer sample, which inhibited the investigation of age as a moderator. Therefore, we employed a sample covering consumers of all age stages in the main study to explore the potential moderating role of age. In addition, we used a different video material and gauged different approaches to measure proenvironmental intention and behavior to generalize the findings.

4.1. Method

4.1.1. Procedure, Participants, and Design

Design and participants. The study employed a single-factor, between-subjects design with participants exposed to a video stimulus (normal speed vs. fast speed). We recruited participants in the U.S. from an online research platform, Prolific Academic. The platform has been found to have higher data quality, less participant dishonesty, and more participant diversity than other online panels [57]. Only desktop users were allowed to take part in the study. Before enrollment, participants were informed that the survey required audio. Prescreening, through Prolific, was conducted to ensure an even gender split. In total, 325 participants were recruited and randomly assigned to the normal-speed video condition ($n = 163$) or the fast-speed video condition ($n = 162$) using the Randomizer function in the online questionnaire (Qualtrics). Of those, twenty-five participants were dropped from further analyses for failing either an attention check question or factual questions about video contents, thus resulting in a final sample of 300 participants (50% female; age in years: $\text{range} = 18\text{--}92$, $M = 37.83$, $SD = 13.78$). The final sample comprised 153 participants ($M_{\text{age}} = 39.07$, $SD = 14.09$) in the normal-speed video condition and 147 participants ($M_{\text{age}} = 36.53$, $SD = 13.38$) in the fast-speed video condition. Preliminary analyses revealed no significant differences between the two playback-speed conditions in terms of gender distribution ($\chi^2 = 0.12$, $p = 0.729$), age ($t = -1.60$, $p = 0.11$), or income ($t = 0.33$, $p = 0.739$), indicating that randomization was successful for these demographic variables. Additional analyses involving the twenty-five excluded participants produced virtually identical results.

Video stimuli. A YouTube video titled “2050: what happens if we ignore the climate crisis” produced by a climate change communicator (i.e., the Guardian News) served as the stimulus (https://youtu.be/RVcsV_erys). While the original video duration was 2.5 min, we kept the first 80 s of the 2.5 min video as the experimental stimuli. The cropped video clip began by displaying scenarios about what life could look like on Earth in 2050 if we do nothing, and ended by giving hope about what life could look like if we take action now. The video featured a female voice and a piece of slightly tense background music. The captions appeared sequentially at the bottom of the scenes. We retained the original 80 s duration for the normal-speed condition and accelerated the playing time to 58 s for the fast-speed condition (video posted on OSF: <https://bit.ly/3z4VFUy>, accessed on 31 May 2022).

Experimental procedure. Following instructions for turning on the sound, participants were randomly assigned to view a video clip in either normal-speed or fast-speed conditions. After viewing the video, participants first answered three factual questions about the video contents and then completed measures of proenvironmental intention, proenvironmental behavior, and climate change urgency perception. At the end of the

survey, participants reported their demographic information (i.e., age, gender, and income). Finally, participants were debriefed and thanked.

4.1.2. Measures

Proenvironmental intention. Participants indicated their proenvironmental intention by responding to three items (adapted from [58]). Specifically, they were asked to indicate the extent to which they intended to purchase the following proenvironmental products: “Buy a water-saving shower head at \$100”, “Buy a bio-degradable battery that is 50% more expensive than a non-degradable battery”, “Buy an energy-saving light bulb that is 50% more expensive than a conventional light bulb”. The assessment was conducted on a 7-point Likert scale (1 = *not likely at all*, 2 = *moderately unlikely*, 3 = *slightly unlikely*, 4 = *neither likely nor unlikely*, 5 = *slightly likely*, 6 = *moderately likely*, 7 = *very likely*). We averaged the three items to create proenvironmental intention ($\alpha = 0.74$; $M = 4.51$, $SD = 1.54$).

Proenvironmental behavior. We used a different scenario to measure proenvironmental behavior (adapted from [59]). Participants were given the opportunity to donate 10 min to help further climate change research by testing an online carbon footprint calculator when the survey was over. They were asked whether they would like to participate. If participants were willing to support this climate change research, they needed to write down their email to receive further information about the test. In contrast, if they had no interest, they could ignore this question. The answer to this question was coded as 0 (not leaving an email) and 1 (leaving an email). We used the option of providing an email as a proxy for actual proenvironmental behavior.

Climate change urgency perception. As in the pilot study, participants indicated their perceived urgency of climate change by responding to four items on a 7-point Likert scale (i.e., “Climate change isn’t a distant threat—it’s happening NOW”, “Climate change is an imminent threat for human beings”, “Climate change requires immediate action”, “We must act NOW to stop climate change”; 1 = *strongly disagree*, 2 = *disagree*, 3 = *somewhat disagree*, 4 = *neither agree nor disagree*, 5 = *somewhat agree*, 6 = *agree*, 7 = *strongly agree*) [26,28]. We averaged the four items to create climate change urgency perception ($\alpha = 0.96$; $M = 6.07$, $SD = 1.45$).

Demographic information. Age was measured by asking participants to report their age in years. Gender was measured as a dichotomous variable, which was dummy-coded (1 = male, 2 = female) in the statistical analysis. Income was measured by the individual’s annual household income (in US dollars), which was dummy-coded into twelve categories (1 = Less than USD 10,000; 2 = USD 10,000–19,999; 3 = USD 20,000–29,999; 4 = USD 30,000–39,999; 5 = USD 40,000–49,999; 6 = USD 50,000–59,999; 7 = USD 60,000–69,999; 8 = USD 70,000–79,999; 9 = USD 80,000–89,999; 10 = USD 90,000–99,999; 11 = USD 100,000–149,999; 12 = More than USD 150,000).

4.1.3. Data Analysis

Data were analyzed with the SPSS. Table 2 shows means, standard deviations, and Pearson correlations between all the variables.

Table 2. Correlation matrix, means, and standard deviations in the main study.

Variables	Speed	Intention	Behavior	Urgency	Age	Gender	Income	Mean	SD
Speed	1							–	–
Intention	–0.088	1						4.51	1.54
Behavior	0.050	0.273 **	1					0.24	0.43
Urgency	–0.023	0.430 **	0.119 *	1				6.07	1.45
Age	–0.092	–0.037	–0.023	–0.328 **	1			37.83	13.78
Gender	0.020	0.162 **	0.054	0.178 **	–0.245	1		1.50	0.50
Income	0.019	0.114 *	0.072	0.037	0.024	–0.124 *	1	6.94	3.57

Note. ** and * denote statistical significance at the 5% and 1% levels, respectively. Speed = video playback speed; intention = proenvironmental intention; behavior = proenvironmental behavior; urgency = climate change urgency perception.

We conducted a moderation analysis with 5000 bootstrap samples ([60], PROCESS Version 3.4, Model 1) to examine the impact of video playback speed on climate change urgency perception, proenvironmental intention, and proenvironmental behavior based on the participants' age (H1, H2, and H3). We used video playback speed (−1: normal, 1: fast) as the independent variable, age as the moderator, and the three outcome variables, respectively, as the dependent variables.

4.2. Results

Climate change urgency perception. The main effect of video playback speed was significant ($b = -0.52$, $SE = 0.23$, $t(296) = -2.26$, $p = 0.025$) and the main effect of age was also significant ($b = -0.03$, $SE = 0.01$, $t(296) = -5.93$, $p < 0.001$). Moreover, the interaction of video playback speed and age on climate change urgency perception was significant ($b = 0.01$, $SE = 0.01$, $t(296) = 2.05$, $p = 0.042$). We subdivided this interaction by testing the simple effects (see Figure 2). For younger participants (−1SD), there was a significant difference ($b = -0.24$, $SE = 0.11$, $t(296) = -2.14$, $p = 0.034$). Specifically, participants in the fast-speed condition ($M = 6.32$) perceived less urgency of climate change than those in the normal-speed condition ($M = 6.79$). There was no significant difference, though, for older participants (+1SD) ($b = 0.09$, $SE = 0.11$, $t(296) = 0.77$, $p = 0.443$). The results revealed that fast playback speed (vs. normal playback speed) reduced younger consumers' climate change urgency perception; for older consumers, video playback speed did not significantly change their climate change urgency perception. Therefore, H1 and H1a were supported, and H1b was not supported.

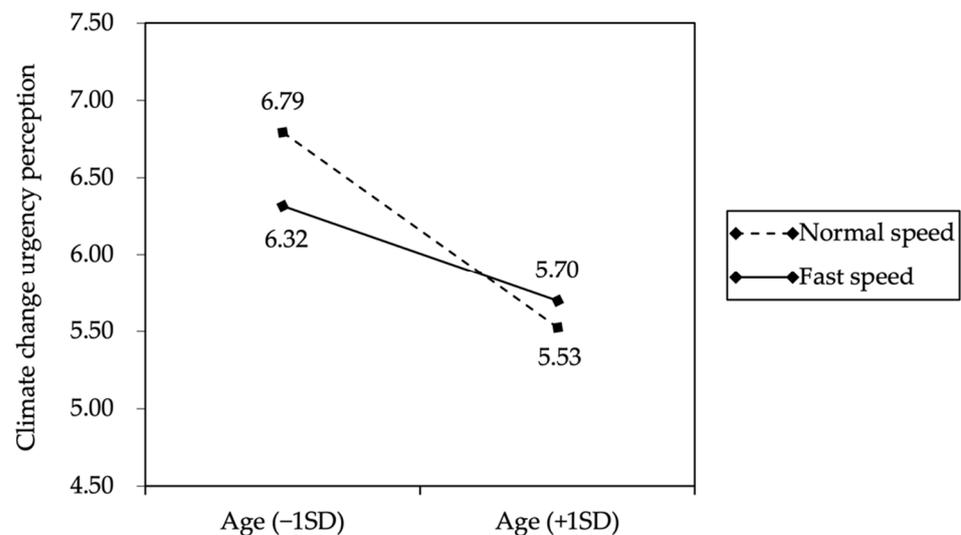


Figure 2. The moderating role of age in the effect of video playback speed on climate change urgency perception in the main study. The solid black line represents the fast-speed condition, and the dotted black line represents the normal-speed condition. Climate change urgency perception was a continuous variable ranging from 1 to 7.

Proenvironmental intention. Neither the main effect of video playback speed ($b = -0.43$, $SE = 0.26$, $t(296) = -1.63$, $p = 0.103$) nor the main effect of age ($b = -0.005$, $SE = 0.01$, $t(296) = -0.71$, $p = 0.481$) on proenvironmental intention was significant. The interaction of video playback speed and age on proenvironmental intention was also not significant ($b = 0.01$, $SE = 0.01$, $t(296) = 1.16$, $p = 0.247$). Therefore, H2 was not supported.

Proenvironmental behavior. Neither the main effect of video playback speed ($b = 0.41$, $SE = 0.40$, $Z = 1.04$, $p = 0.300$) nor the main effect of age ($b = -0.004$, $SE = 0.01$, $Z = -0.36$, $p = 0.723$) on proenvironmental behavior was significant. The interaction of video playback speed and age on proenvironmental behavior was also not significant ($b = -0.01$, $SE = 0.01$, $Z = -0.80$, $p = 0.423$). Therefore, H3 was not supported.

5. General Discussion

5.1. Results Discussion

The current study focuses on a novel communication strategy embedded in audio-visual stimuli for promoting awareness of climate change urgency and sustainable behavior. We considered the differentiated effects among consumers from different age groups. Accordingly, we conducted two studies to examine the impacts of video playback speed on consumers' climate change urgency perception, proenvironmental intention, and proenvironmental behavior.

Specifically, the pilot study provided preliminary evidence that fast playback speed had a negative effect in influencing the perceived urgency of climate change for the young consumer sample, but had no influence on their proenvironmental intention and proenvironmental behavior. Using a sample including both younger and older consumers, the subsequent main study examined the moderating role in the effect of video playback speed on climate change urgency perception and proenvironmental outcomes. The results showed that age moderated the impact of video playback speed on climate change urgency perception, such that fast-speed video was less effective than normal-speed video in increasing the perceived urgency of climate change among younger but not older consumers. However, the effects of video playback speed on proenvironmental intention and proenvironmental behavior were not moderated by age.

Therefore, the results suggest that a fast playback speed of a climate change video would be less influential in shaping consumers' urgency perception than the normal playback speed, and the diminishing effects exist only among younger (not older) consumers. It may seem counterintuitive that consumers would perceive less urgency from those seemingly "urgent" videos, as visual sensory experience may shape perceptions [61]. However, there is a possibility that consumers may gain less information from the same climate change video playing faster than normal [19], thus forming a less urgent perception of the focal issue.

The contingent effects for different age groups are consistent with the findings that younger consumers have a greater capability for central information elaboration than their older counterparts [40], thus being more susceptible to the change of video playback speed in forming relevant attitudes. However, we did not observe a significant positive effect for a fast playback speed on climate change urgency perception for the older consumer as hypothesized, which implies that video playback speed may not be pertinent enough as a peripheral cue to infer urgency about the focal issue.

Notably, the video playback speed did not influence proenvironmental intention and behavior regardless of consumers' age, which may imply a weak and distant linkage between video playback speed variation and behavioral change. One possibility might be that the videos selected and employed in the current research addressed information about the acute "problem" of climate change and the severe need to deal with it, rather than affirming the significance of relevant proenvironmental action [62]. Our findings comport with previous studies that threat messages may not necessarily elicit behavioral change, especially when without efficacy information [63].

5.2. Theoretical Contributions

The current research offers several theoretical contributions.

First, our research contributes to the scarce literature regarding consumer perceptions of multimedia stimuli with various playback speeds. Prior studies have examined how multiple levels of video playback speed affect individuals' perception of products [18,19], advertisements [20,21], people [22,23], and time [24,25], as well as subsequent behavior such as purchase intention [21]. Our work is unique in examining how the peripheral cue of playback speeds may influence climate change urgency perception and proenvironmental intention and behavior.

Second, our research adds to the emerging proenvironmental literature that employs video interventions. Despite the use of video as an effective tool in motivating customers to exhibit positive attitudes and behavior toward environmental protection, most studies ma-

nipulated the video contents, such as nature scenes [64] and guilt-provoking environmental deterioration scenarios [65]. In contrast, less scholarly attention has been paid to studying the displaying characteristics of video stimuli, particularly the playback speed. The present study demonstrates the intervening effects of video playback speed on proenvironmental intention and behavior, although the findings yield no significant results.

Third, our research contributes to the literature on climate change urgency, which has recently received growing attention [26]. By defining the concept of urgency from both the issue and the action aspects, we develop a climate change urgency perception measurement that has good internal consistency across the two samples. Hence, the present study contributes to the climate change urgency literature by examining the intervening effects of video playback speed on climate change urgency perception.

Fourth, the contingent effect of playback speed on urgency perception supports our theoretical arguments derived from the elaboration likelihood model [35] and the elaboration deficit hypothesis [42]. As climate change urgency becomes a strong argument, a fast playback speed may reduce attitude-related persuasion (i.e., the perceived urgency of climate change) by inhibiting the elaboration of audio–visual messages. However, the undermining effect only exists among younger consumers, who are assumed to be more capable of engaging in high cognitive elaboration activities than older consumers [40].

5.3. Practical Implications

The current research can provide the following practical implications for marketers and policymakers.

First, as a relative controllable element in communication, playback speed has the potential to affect the effectiveness of audio–visual stimuli. While some believe that a fast speed signifies urgency, according to our conclusions, companies and governments should be cautious about using sped-up videos to express urgent content. The playback speed may not be an efficient signal to convey urgency, as fast playback speed of video may lead to less understanding of the focal issue. Hence, video makers should give the audience sufficient time for information processing by accelerating playback speed within a moderate range.

Second, a tailoring strategy that employs fast playback speed should be considered for climate change urgency communication. As mentioned in the current research, the playback speed reduces urgency perception only for younger consumers, who are supposed to have a higher ability for information elaboration. Consequently, video communicators need to consider the elaboration heterogeneity of the audience and match them with messages of various levels of cognition needs, thus improving communication effectiveness.

5.4. Limitations and Future Research

As an exploratory article, some limitations should be noted. First, the present research only compares two playback-speed conditions. However, there may be a nonlinear relationship between video playback speed and urgency perception. Therefore, future work is required to examine at least three playback-speed conditions (e.g., normal (1.0×), fast (1.25×), and faster (1.5×) speeds) and establish more refined prediction effects of the video playback speed.

Second, the pilot study only tests the main effect of video playback speed among a young consumer sample, leaving only a single study (i.e., the main study) eligible to test the moderating role of age. Therefore, future work should be conducted to enhance the robustness of age as a moderator.

Third, our research tests only two video materials. There may be a possibility that video contents accidentally lead to the results, limiting generalizations of the conclusions. While materials in our study heavily rely on cognitive elaboration but not emotional arousal, future work may find it interesting to examine whether other types of video materials would be more affected by the variation of playback plays, such as those involving emotional elements (e.g., fear, guilt) and those relying on weak arguments.

The current research sheds additional light on future directions. Based on our preliminary results, further research may investigate the mechanism underlying the relationship between video playback speed and urgency perception. While we reason that video with a fast playback speed may garner less attention [38] and thus equip less information for attitude changes [19], future research could also examine other accounts. For example, consumers may detect the ulterior motivations behind the accelerated playback speed, leading to psychological reactance and less persuasive effects [66].

While the present research identifies age as a moderating factor in the effect of video playback speed on urgency perception, researchers should also examine other moderators. For example, the effect of playback speed may depend on the individual's level of environmental involvement. There is a possibility that consumers with low environmental involvement would be more influenced by peripheral persuasion (i.e., playback speed) than those highly involved in environmental issues.

In addition, it is worth investigating the repeated persuasive effects of exposure to fast playback speed videos communicating climate risks. Our laboratory experiment research suggests that playback speed per se is insufficient to affect attitudes and behaviors in a single intervention episode; however, little is known about the accumulated effects of accelerated video materials on consumers' urgency perception and subsequent behavior. Therefore, future research could investigate how multiple and continual exposures to a series of fast playback speed videos affect consumers' climate change urgency perception and proenvironmental intention and behavior in a more real media setting such as social media.

Finally, future work may find it worthwhile to investigate other marketer-controllable elements to promote a sense of urgency in audio–visual climate change communication. For example, by displaying a visual pulse at a fast rate in the background with a corresponding auditory pulse rate, the stimuli may lead to higher perceived urgency [67].

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