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Social distancing and prosocial behaviors: The replenishing effect of intense visual stimulation

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ABSTRACT

COVID-19 has disrupted lives across the world. This research investigates the psychological and behavioral consequences of social distancing, which is being globally practiced to contain its spread. Using seven experiments, we document the moderating role of high-intensity visual stimulation on social distancing’s effect on psychologically distressed individuals’ prosocial intentions and behaviors. The results reveal that social distancing resulted in ego depletion; however, exposure to high-intensity visual stimuli replenished cognitive resources and increased prosocial intentions and behaviors among those experiencing psychological distress due to social distancing.

1. Introduction

To contain the spread of COVID-19, lockdowns and strict social distancing measures have been implemented, which physically constrained people and evoked widespread psychological distress (Howard, 2020; Wan, 2020). There are reports of an unprecedented wave of mental health problems, such as depression, anxiety, and post-traumatic stress disorder (Wan, 2020). Self-regulation can suppress the innate desire for social connection and manage the symptoms of such disorders (Baumeister et al., 1998). However, engaging in a self-regulatory activity depletes a common energy resource and impairs the subsequent activities until the relevant resources are replenished (DeWall et al., 2008; Muraven & Baumeister, 2000; Tice et al., 2007). Ego depletion diminishes prosocial behavior (DeWall et al., 2008; Jin et al. 2021; Osgood & Muraven, 2015; Xu et al., 2012). Consistent with ego depletion theory, this research examines whether practicing social distancing induces psychological distress—its management reduces the self-regulatory energy needed for subsequent self-regulatory activities involved in prosocial behavior.

The “new normal” and COVID-19 trauma may linger for a long time after extended periods of isolation and risk (Fisher, 2020). Psychology, neuroscience, and political science researchers advocate that “prosocial behavior” is a key to surviving this crisis and the challenges of long-term social distancing (Fisher, 2020). From isolated families and neighbors to people in countries lacking hygienic resources and systems to fight the disease, urgent attention and aid are needed worldwide. This research raises a novel question: can prosocial behavior be increased in these turbulent times through interaction with certain kinds of visual stimuli? Investigating novel ways to replenish self-regulatory resources is paramount during these times as helping others is a depleting act (DeWall et al., 2008).

Bright and saturated colors elicit arousal (Valdez & Mehrabian, 1994) and boost self-worth (Batra & Ghoshal, 2017). Thus, this research examines visual stimulation’s role in helping individuals cope with the pandemic-related psychological crisis. We conducted seven experiments to demonstrate how visual stimulation helps restore the depleted self and leads to prosocial behaviors necessary during the pandemic.

2. Social distancing and self-control

Social distancing, also called physical distancing, means “keeping a safe space between yourself and other people who are not from your household” (CDC, 2020). However, its protocols during COVID-19 include more than keeping a minimum six feet distance from others. The prevalent social distancing measures, although not uniform across countries and states, refer primarily to working or schooling from home, avoiding social gatherings, and discretionary travel (Gittleson, 2020; Park et al., 2020).

Social distancing during COVID-19 is characterized by extensive self-control, whether it is self-motivated or forced. Social distancing...
generates motivational conflicts between the natural desire for social connection and socially responsible behavior during the pandemic. The innate desire for social connection is rooted in motivational theories concerning everyday desires to engage in activities associated with pleasure or relief from discomfort (Hofmann et al., 2012). People strive to enact their desire unless it conflicts with their values, goals, or standards or is impeded by external constraints. When conflicts occur, self-control processes are activated (Hofmann et al., 2012). Hence, we predict that social distancing is a constraint on the natural human desire for connection. Therefore, practicing it requires immense self-control. According to Devora Kestel, the head of the Department of Mental Health and Substance Use at the World Health Organization (WHO), isolation, fear, uncertainty, and economic turmoil during the COVID-19 crisis could constitute forms of “psychological distress” (Togoh, 2020). Similarly, health experts and the latest data warn about rising mental health problems—specifically, depression and anxiety—which indicates that this pandemic and its structural changes to society pose insidious consequences on our mental health (CDC, 2020; Wan, 2020). Accordingly, we hypothesize that the unprecedented social distancing and quarantining increase psychological distress, which induces ego depletion.

3. Ego depletion and replenishment

Ego depletion refers to “a temporary reduction in the self’s capacity or willingness to engage in volitional action caused by the prior exercise of volition” (Baumeister et al., 1998). Studies suggest that acts of volition draw on a common inner resource of a limited capacity (Baumeister et al., 1998; DeWall et al., 2008; Muraven & Baumeister, 2000). Thus, engaging in a self-regulatory activity impairs subsequent self-regulatory activities unless this resource is replenished (Muraven & Baumeister, 2000).

Prior research revealed that coping with stress and regulating mood consume the limited strength needed for self-control, causing poorer self-control performance. Moreover, exposure to stressful, uncontrollable situations decreases the ability to exert self-control even after the stress has ended (Muraven & Baumeister, 2000).

The ego depletion theory proposes an important implication for this pandemic situation. First, it suggests that self-control resources are depleted more than usual due to coping with extraordinary stress and negative emotions caused by social distancing and quarantining. Second, this reduction in self-regulatory resources could generate various social problems. Poor lifestyle habits of excessive smoking, drinking, and eating may return (Baumeister & Heatherton, 1996), and violence may increase due to impairment of social abilities necessary for human coexistence, including tolerance, persistence, resistance to temptations, and delaying gratification (Muraven & Baumeister, 2000). Depleted individuals are less willing to help others (DeWall et al., 2008; Jin et al., 2021; Osgood & Muraven, 2015; Xu et al., 2012), and high levels of self-control lead to prosocial behavior (Dong et al., 2019; Wang et al., 2021).

However, self-regulatory resources can be replenished after ego depletion, for example, by drinking glucose-containing beverages (DeWall et al., 2008), inducing positive emotions (Tice et al., 2007), resting (Tyler & Burns, 2008), and affirming the self (Schmeichel & Vohs, 2009). In this research, we posit that exposure to high-intensity sensory stimulation is an ego-replenishing activity. We investigate whether stimulation through high-intensity visual input restores self-regulatory resources following depletion due to social distancing.

4. Sensory stimulation and visual intensity

The existing research on embodied cognition suggests a symbolic link between sensory inputs and abstract concepts (Landau et al., 2010). Exposure to visually intense stimuli, such as bright colors, “fills up” one’s senses by generating feelings of being energized (Valdez & Mehrabian, 1994), and boosts self-worth by inducing arousal and reducing rumination on negative experiences through distraction (Batra & Ghoshal, 2017). Thus, consuming high-intensity colors restores the self and could serve as a self-affirming remedy to the depleted ego (Schmeichel & Vohs, 2009). Hence, we hypothesize that bright and saturated colors replenish ego-depleted individuals’ resources, with the richness and fullness of hues generating a sense of being full of energy resources. We predict that social distancing during COVID-19 causes psychological distress because of the unprecedented physical and social confinements affecting the daily lives. Higher levels of social distancing would generate higher levels of restrictions and changes in our personal, social, and economic lives which cause mental distress. However, according to the aforementioned literature, the distressed individual, who may otherwise act selfishly, may be motivated to act prosocially if presented with high (vs. low) intensity sensory stimuli. Thus, we predict that individuals who practiced more social distancing would display higher psychological distress unique to the pandemic, namely, feelings of uncertainty, fear, isolation, and financial anxiety. This psychological state of distress would be counteracted by high-intensity visual stimuli, for example, products with bright and saturated colors. Consequently, mentally restored individuals exposed to high-intensity visual stimuli would be replenished and can engage in another self-controlling activity, such as behaving prosocially. In brief:

H1. Socially distanced individuals experience psychological distress, and behave more prosocially when exposed to high-intensity visual stimuli.

Building on this idea, we also predict that social distancing, which requires extended exertion of self-control, depletes self-regulatory resources and impairs self-regulatory performance. However, when an activity replenishes self-regulatory resources, subsequent self-control performance is not impaired (DeWall et al., 2008; Tice et al., 2007). We posit that high-intensity visual stimulation restores the depleted ego and thus, positively affects subsequent self-regulatory prosocial behaviors (see Fig. 1):

H2. Socially distanced individuals experience psychological distress, leading to ego depletion, and exposure to high-intensity visual stimuli increases their prosocial behavior.

H3. Socially distanced individuals experience psychological distress, and exposure to high-intensity visual stimuli generates sensory replenishment—that is, the sense of richness and fullness of the intense color increases their prosocial behavior.

5. Interdependent self-construal and social distancing

Finally, as social distancing severely restricts social interactions, we posit that it disrupts interpersonal contact. Thus, highly interdependent individuals would suffer more from losing social connections and group identity. As individuals with interdependent self-construals have a higher need for social interaction (Markus & Kitayama, 1991), they may be more affected by social distancing than those with independent self-construals. Furthermore, compared to independent individuals, interdependent individuals regulate others’ standards to a more considerable degree and feel more responsible toward others (Gardner et al., 1999; Markus & Kitayama, 1991). Hence, abiding by and exerting self-control for nationwide social distancing mandates may be more difficult for them. Therefore, we propose that socially distanced interdependent individuals would experience greater ego depletion and be more affected by the replenishing feature of high-intensity visual stimuli during the pandemic.

H4. Individuals with interdependent (vs. independent) self-construals become more replenished when exposed to high (vs. low) intensity visual stimulation in a social distancing (vs. control) setting.

The proposed hypotheses were tested in seven studies. In Study 1, by manipulating color intensity (high vs. low), we showed that high-
intensity visual stimuli mitigate psychological distress and increase prosocial behavior among individuals practicing social distancing (H1). Study 2A developed the findings of Study 1 by examining sensory replenishment from the high-intensity visual stimuli as an underlying process (H3). In Study 2B, psychological distress due to COVID-19 was manipulated to establish its causal effect on ego depletion explicitly measured using a mental arithmetic task (H2). Using a moderated serial multiple mediation model, Study 3 examined the interaction effect between psychological distress and visual intensity on prosocial behaviors through the mediating effect of sensory replenishment. In Study 4A, we manipulated social distancing using a recall task, further supporting the ego depletion hypothesis (H3). In Study 4B, we tested our prediction that social distancing disrupts interpersonal contact, which leads to psychological distress, using the moderating effect of interdependent self-constructs affecting ego depletion (H4). Finally, in Study 5, we tested if the effect of high-intensity color influences participants’ behaviors by soliciting donations for real charities. Studies 1, 2A, and 3 were completed in the United States (US) in late April 2020. Study 4B was conducted in mid-October 2020, Study 5 in mid-June 2021, and Studies 2B and 4A in mid-March 2022 in South Korea.

6. Study 1

In Study 1, we examined the consequences of social distancing on prosocial intentions and investigated how visual intensity can mitigate its effect. We hypothesized that social distancing generates psychological distress, while exposure to high-intensity visual stimuli increases prosocial intentions among psychologically distressed individuals.

6.1. Method

Stimuli. To test the effect of high-intensity sensory stimuli, we created two sets of images of three products using high- or low-intensity colors. Hues and saturation levels can generate high-intensity sensory stimulation (Batra & Ghoshal, 2017; Valdez & Mehrabian, 1994). Consistent with prior research (Batra & Ghoshal, 2017), we contrasted products equivalent in their color hues but differing in their saturation or intensity (see Appendix A). The saturation level increases as the colors become more vivid. We designed the test stimuli using the website Zazzle (https://www.zazzle.com), an online marketplace for custom products. A cushion, a notebook, and a smartphone case were selected as equivalent in their color hues but differing in their saturation or intensity visual stimuli.

Procedure. A total of 101 Amazon Mechanical Turk (MTurk) workers located in the US participated in a two-condition (intensity: high vs. low) between-participants experiment for $1.50 compensation. After excluding three self-declared colorblind participants, there were 98 usable responses for the final analysis ($M_{age} = 39.26$ years; 34 females). We measured the extent of social distancing practiced by the participants during the pandemic using three items (“I try to keep a physical distance of at least six feet in public spaces,” “I do not participate in group gatherings,” “I stay at home and avoid going out”); $1 = \text{strongly disagree}, 7 = \text{strongly agree}$. Their psychological distress levels related to the pandemic were measured using two items (“Feeling uncertain about when COVID-19 will end,” “Worrying about me and my family getting infected”); $1 = \text{not at all}, 7 = \text{very much}$.

Then, participants were randomly shown three different images of products in high- or low-intensity colors. They indicated how likely they would practice prosocial behaviors directly related to the pandemic were measured using two items (“Feeling uncertain about when COVID-19 will end,” “Worrying about me and my family getting infected”); $1 = \text{not at all}, 7 = \text{very much}$.

Manipulation check. Participants’ ratings of how “intense” and “vivid” each color felt for the three-color stimuli were averaged to form manipulation check index ($\alpha = 0.897$). Those in the high-intensity condition ($M = 5.09, SD = 1.05$) perceived the colors to be significantly more intense than those in the low-intensity condition ($M = 3.27, SD = 1.53; F(1, 96) = 47.41; p < .001)$.

Social distancing and prosocial intentions. We predicted that socially distanced individuals experience psychological distress during COVID-19, and exposure to high (vs. low) intensity visual stimuli would mitigate its effect on prosocial intentions (H1). This moderated mediation model was tested using Hayes’ PROCESS Model 14 with 5,000 bootstrapping samples (Hayes, 2018), including social distancing as the independent variable, prosocial intentions as the dependent variable, psychological distress as the mediator, visual intensity as the moderator, and preference for bright colors as a covariate. We averaged the three prosocial-distancing items, the two psychological-distress items, and the four prosocial-intention items to create indices for the social distancing measure (Cronbach’s $\alpha = 0.815$), psychological distress ($r = 0.604$), and prosocial intentions ($\alpha = 0.838$).

The index of moderated mediation corroborated that social distancing induces psychological distress and exposure to high-intensity...
visual stimuli moderates this effect on prosocial intention ($b = 0.21$, 95% confidence interval (CI) [0.042, 0.566]). Specifically, during high-intensity visual stimulation, social distancing’s indirect effect on prosocial intention through psychological distress was significant ($b = 0.26$, 95% CI [0.085, 0.603]). During low-intensity visual stimulation, such indirect effect was not significant ($b = 0.05$, 95% CI [-0.084, 0.191]; see Fig. 2). The results of Study 1 support H1, showing that socially distanced individuals experienced psychological distress about COVID-19, and when exposed to highly saturated colors, they displayed more prosocial intentions.

7. Study 2A

Study 2A had two objectives. To provide convergent evidence to support Study 1’s findings for which we examined the replenishing mechanism of high-intensity visual stimuli on the depleting effect of psychological distress during the pandemic. The second was to rule out visual density’s role, showing that the effect of color saturation on prosocial intentions persists regardless of visual density. We manipulated visual intensity using color saturation; its level reflects the amount of pigmentation of the color (Batra & Ghoshal, 2017, p. 7). A dense (vs. sparse) pattern induces feelings of fullness that help alleviate psychological emptiness caused by social exclusion (Su et al., 2019). We posited that if social distancing causes psychological emptiness and dense patterns provide a sense of fullness, the effect of visual intensity would be attenuated. Hence, we asked the participants to evaluate a product with highly dense patterns and with color designs where we manipulated high versus low visual intensity.

7.1. Method

Stimuli. This study employed a two cell (intensity: high vs. low) between-participants design. For this study, the green-colored cushions with high or low saturations as in Study 1 were created but with much denser patterns. On top of the green-colored cushions where only six dots were sparsely spread in Study 1, over 500 dots were lined up densely (see Appendix A).

Procedure. A total of 85 MTurkers in the US participated in the study for $1.50 compensation. Excluding four self-declared colorblind participants, 81 observations were available for analysis ($M_{age} = 39.43$ years; 35 females). First, we measured their psychological distress during COVID-19 using four items (“Feeling uncertain about when COVID-19 will end,” “Worrying about me and my family getting infected,” “Feeling restricted by limited outside and physical activities,” and “Feeling burdened and anxious financially”: 1 = not at all, 7 = very much). Then, they randomly evaluated a green-colored cushion. To measure their sensory replenishment, the sense of richness and fullness of the intense color, the participants were asked to evaluate the product’s color on two descriptive items (The word “rich,” “full”: 1 = does not describe the color of the cushion, 7 = describes the color of the cushion well).

Then, they indicated their willingness to perform COVID-19-related prosocial behaviors using the same four items as in Study 1. Finally, participants completed manipulation check items and reported their preference for bright colors, and answered questions related to color blindness and demographics.

7.2. Results and discussion

Manipulation checks. Participants’ responses to the two items ($r = 0.907$) were averaged to form a visual intensity manipulation check index. Those in the high-intensity condition ($M = 5.85, SD = 1.01$) perceived the stimuli’s color to be significantly more intense than those in the low-intensity condition ($M = 3.20, SD = 1.91; F(1, 79) = 61.38, p < .001$).

Visual intensity and prosocial intentions. We conducted a moderated mediation analysis using PROCESS Model 7 with a preference for bright colors, and answered questions related to color blindness and demographics.

Visual intensity and prosocial intentions. We conducted a moderated mediation analysis using PROCESS Model 7 with a preference for bright colors as a covariate, psychological distress as the independent variable ($\alpha = 0.742$), prosocial intentions as the dependent variable ($\alpha = 0.791$), intensity as the moderator, and sensory replenishment as the mediator ($\alpha = 0.751$). All composite measures were created by averaging the items described in the procedure. The results revealed a significant conditional indirect effect on prosocial intentions through the sensory replenishment from the visually intense stimuli ($b = 0.18, 95\% CI [0.014, 0.474]$). The indirect effect on prosocial intentions was significant in the high-intensity condition ($b = 0.15, 95\% CI [0.019, 0.337]$), but not in the low-intensity condition ($b = -0.03, 95\% CI [-0.223, 0.083]$) (see Figs. 3 and 4).

Discussion. The results of Study 2A reinforce the effect of visual intensity on prosocial intentions regardless of the difference in pattern density, another design element. People who were psychologically distressed during COVID-19 experienced a sense of richness and fullness, that is, sensory replenishment from the stimulus with an intense color. Subsequently, the sensory replenishment led to an increase in prosocial intentions.

8. Study 2B

In Study 2B, psychological distress due to COVID-19 was manipulated to establish its causal effect on ego depletion. More importantly, we explicitly measured ego depletion using three tasks.

8.1. Method

Stimuli. We employed a 2 (intensity: high vs. low) × 2 (psychological distress) × 2 (social distancing) between-participants design.
distress: high vs. low) between-participants design. For this study, the two versions of a green-colored cushion, an orange-colored notebook case, and a blue-colored smartphone case with high or low intensity were created similar to Study 1 but without any patterns (see Appendix A).

Procedure. A total of 178 participants were recruited from a university in South Korea and paid 10,000 Korean won (approximately US$8) for a 45 min session that included four studies, with this study being the first ($M_{age} = 22.50$ years; 125 females). First, participants were randomly assigned to one of two psychological distress manipulation conditions. Those in the high psychological distress condition were instructed to carefully read a newspaper article titled “The psychological impact of COVID-19: endless anxiety, restriction and frustration” extracted from published sources. Those in the low psychological distress condition read a newspaper article titled “The psychological impact of COVID-19: prospects for nearing the end and hopes for recovery”. Then, as a manipulation check measure, we assessed their psychological distress during COVID-19 using five items (“Feeling uncertain about when COVID-19 will end,” “Worrying about me and my family getting infected,” “Feeling restricted by limited outside and physical activities,” “Feeling burdened and anxious financially,” and “Feeling isolated”: $1 = not at all, 7 = very much). After participants reviewed three images of products with high- or low-intensity color for a minute at random, three different tasks were administered to assess their ego depletion. They were first given 1 min to solve 30 arithmetic problems, as many as they could, without using a calculator. Such mental arithmetic tasks were used in previous research to measure the amount of self-control individuals can exert (Lisjak et al., 2012). Next, they were presented with a 5-item Remote Associates Test (RAT; Mednick, 1962) wherein they were given a series of three words and instructed to come up with a fourth one that was related in some way to each. For example, participants might be presented with “car,” “swimming,” and “cue,” and the correct response would be “pool.” After completing the RAT task for 2 min, they proceeded to engage in three analytical reasoning problems taken from the LSAT (The Law School Admission Test; Lisjak et al., 2012, Study 5) for 2 min.

Finally, they indicated their intentions to practice COVID-19-related prosocial behaviors directly related to the pandemic situation using an item used in Studies 1 and 2A (“Donating blood as hospitals experience a shortage during COVID-19 crisis;”; $1 = very unlikely, 7 = very likely), and reported their preference for bright colors, and answered questions related to color blindness and demographics.
8.2. Results and discussion

**Manipulation checks.** Participants’ responses to the psychological distress manipulation check items \((a = 0.603)\) were averaged to form a manipulation check index. Those in the high-distress condition \((M = 4.82, SD = 0.99)\) reported higher distress than those in the low-distress one \((M = 4.32, SD = 1.14; F(1, 176) = 9.56, p = .002)\).

**Ego replenishment and prosocial intentions.** We conducted a moderated mediation analysis using PROCESS Model 7 with manipulated psychological distress as the independent variable, prosocial intention as the dependent variable, visual intensity as the moderator, and ego depletion, measured by the number of correct answers to the mental arithmetic questions, RAT, and LSAT items as the mediator. The index of moderated mediation confirmed a significant conditional indirect effect due to the replenishment from the visually intense color stimuli \((b = 0.19, 95\% CI [0.001, 0.479])\). The indirect effect on prosocial intention was significant in the high-intensity condition \((b = 0.14, 95\% CI [0.002, 0.356])\), but not in the low-intensity one \((b = -0.06, 95\% CI [-0.212, 0.078])\) (see Fig. 5).

**Discussion.** The results of Study 2B established the causal effect of psychological distress on ego depletion providing evidence for psychological distress as the underlying mechanism. Psychologically distressed individuals during COVID-19 solved more LSAT problems and performed better on arithmetic calculation and the RAT after exposure to visually intense stimuli, which subsequently generates enhanced prosocial intentions.

8.3. Study 3

Study 3 replicated the findings of Studies 1, 2A, and 2B in a different context using different color stimuli. We used a comprehensive moderated serial multiple mediation model to examine the interaction effect between psychological distress and visual intensity on prosocial behaviors through the mediating effect of ego replenishment for the socially distanced individuals during the pandemic.

8.4. Method

**Stimuli.** We created two images of yellow-colored t-shirts by altering their color saturation (see Appendix A). We maximized the saturation of the yellow t-shirt and used it in the high-intensity condition, and distinctly lowered the saturation level for the low-intensity condition. We chose yellow, different from the hues used in Studies 1 and 2, to increase the robustness of our findings.

**Procedure.** A total of 100 MTurkers located in the US participated in the study and were paid $1.50 compensation. After excluding five self-declared colorblind people, there were 95 participants \((M_{age} = 39.61\) years; 35 females). We first measured the extent to which they practiced social distancing using the same items as in Study 1 and their psychological distress levels using the same items as in Study 2A. Then, they were randomly assigned to one of the two between-participant conditions wherein they viewed a t-shirt with either a highly or slightly saturated color. Next, they indicated the extent to which they sensed replenishing qualities of the color’s richness and fullness from viewing the t-shirt and their intentions to engage in prosocial behaviors using the same four items as in Studies 1 and 2A. Finally, participants completed manipulation check items and reported their preference for bright colors, and answered questions related to color blindness and demographics.

8.5. Results and discussion

**Manipulation check.** The participants’ ratings on how “intense” and “vivid” the color felt were averaged to form manipulation check index \((r = 0.937)\). Those in the high-intensity condition \((M = 5.82, SD = 1.18)\) perceived the t-shirt color to be significantly more intense than those in the low-intensity one \((M = 2.34, SD = 1.76; F(1, 93) = 129.44, p < .001)\).

**Ego replenishment and prosocial intentions.** The three items assessing participants’ social distancing practice, the four measuring their psychological distress, and the four measuring intentions for prosocial behaviors were averaged to form the indices of social distancing \((a = 0.903)\), psychological distress \((a = 0.767)\), and prosocial intention \((a = 0.850)\), respectively. We posited that practicing social distancing generates psychological distress, and when the distressed individuals are exposed to high (vs. low) intensity visual stimulation, they feel that the color is replenishing and hence, show more prosocial intentions. We tested this hypothesis using a composite index of the sensory replenishment from the color created by averaging participants’ ratings on how “rich” and “full” the t-shirt color feels \((r = 0.664)\).

Moderated serial mediation analyses were conducted using PROCESS Model 91 controlled for preference for bright colors as a covariate. They confirmed that the paths from psychological distress to sensory replenishment as the mediators and high- versus low-intensity visual stimulation as the moderator were significant \((b = 0.06, 95\% CI [0.006, 0.142])\). The indirect effect of the serial mediation of the path from psychological distress to the sensory replenishment was significant in the high-intensity condition \((b = 0.05, 95\% CI [0.006, 0.112])\), but not significant in the low-intensity one \((b = -0.01, 95\% CI [-0.056, 0.025])\); see Fig. 6).

**Discussion.** A comprehensive analysis in Study 3 provided further support for the high-intensity color’s role in replenishing self-regulatory resources in individuals depleted by social distancing during COVID-19. When socially distanced individuals suffering psychological distress were exposed to visual stimulus high (vs. low) in color saturation, they gained replenishment from the color and, showed higher intentions to behave prosocially.
9. Study 4A

Study 4A was conducted to replicate our findings in Study 3 and more importantly, to demonstrate the causal effect of social distancing on psychological distress, leading to ego depletion. We achieved this by priming social distancing using a recall task and explicitly measuring ego depletion using a RAT.

9.1. Method

Stimuli. Study 4A employed a 2 (intensity: high vs. low) × 2 (social distancing: distancing vs. control) between-participants design. We created two yellow-colored t-shirts by altering their color saturation levels (see Appendix A). For the high-intensity condition, we chose an intense shade of yellow color, the color used in Batra and Ghoshal’s (2017) research. For the low-intensity one, we lowered only the saturation level fixing hue and lightness to create a dull yellow color.

Procedure. A total of 176 university students were recruited from a university in South Korea and paid 10,000 Korean won (approximately US$8) for a one-hour session that included four studies, with this being the first (M_{age} = 22.48 years; 120 females). Participants were randomly assigned to one of the four experimental conditions. Those in the distancing condition were given 5 min to write down their thoughts and feelings on social distancing practices. Those in the control condition did an unrelated writing task for 5 min. Next, we measured their psychological distress during COVID-19 using five items from Study 2B. Then, all were asked to take a minute to randomly evaluate a t-shirt with high- or low-intensity color. After the participants completed the same intensity manipulation check items as in the previous studies, they were given 2 min to take a 3-item RAT similar to the one used in Study 2B. Finally, participants reported their preference for bright colors, and answered questions related to color blindness and demographics.

9.2. Results and discussion

Manipulation checks. Participants’ responses to the two items (r = 0.759) were averaged to form a visual intensity manipulation check index. Those in the high-intensity condition (M = 5.55, SD = 1.12) perceived the stimuli’s color to be significantly more intense than those in the low-intensity one (M = 1.96, SD = 1.02; F(1, 174) = 493.12, p < .001).

Social distancing and ego depletion. We conducted a moderated mediation analysis using PROCESS Model 14 with social distancing as the independent variable (distancing = 1, control = 0), psychological distress as the mediator, visual intensity as the moderator (high = 1, low = 0), ego depletion as the dependent variable, and preference for bright colors as a covariate. We averaged the five psychological-distress items to create a psychological distress index (α = 0.584). Ego depletion was measured by the number of correct answers to the RAT questions.

Consistent with our expectation, the index of moderated mediation confirmed that social distancing induces psychological distress and exposure to high-intensity visual stimulation moderates its effect on ego depletion (b = 0.12, 95% CI [0.005, 0.267]). In high-intensity visual stimulation, the indirect effect of social distancing on ego depletion through psychological distress was significant (b = 0.12, 95% CI [0.017, 0.228]). In the low-intensity one, such indirect effect was not significant (b = −0.01, 95% CI [−0.093, 0.069]; see Fig. 7).

Discussion. The results of Study 4A demonstrated the causal effect of social distancing on psychological distress. The effect of psychological distress induced by social distancing on ego depletion level was reduced when exposed to visually intense stimulation.

10. Study 4B

Study 4B had two purposes. First, to demonstrate the causal effect of the interaction between social distancing and visual stimulation on ego depletion by priming social distancing using a recall task and explicitly measuring ego depletion using a mental arithmetic task. Second, to show that unlike other factors impacting prosocial behavior during the pandemic such as financial and health worries, and other interruptions to routine, or boredom, social distancing disrupts interpersonal contact. We show this effect by examining the moderation effect of independent versus interdependent self-construals. We hypothesized that because individuals with more accessible interdependent self-construals treasure contact and relationships with others, social distancing affects them more. Thus, the high-intensity color would have a stronger ego-replenishing effect on the interdependent self-construal in a socially distanced setting.

10.1. Method

Stimuli. Study 4B employed a 2 (intensity: high vs. low) × 2 (social distancing: distancing vs. control) between-participants design same as in Study 4A. The same two yellow-colored t-shirts from Study 4A were used.

Procedure. A total of 150 university students were recruited in South Korea and paid 10,000 Korean won (approximately US$8) for a one-hour session that included four studies, with this study being the first. After excluding four self-declared colorblind students and seven students who failed to complete the questionnaire indicating their prosocial intentions and color preferences, 139 usable responses (M_{age} = 22.51 years; 97 females) remained. Similar to Study 4A, participants were assigned to one of the four conditions at random and engaged in the same recall task manipulating social distancing practice. After all were randomly evaluated using a t-shirt with high- or low-intensity color, the participants were given 1 min to solve 30 arithmetic problems to measure their ego depletion. After they completed the same intensity manipulation check items as in the previous studies, we assessed their interdependent self-construals using the six-item independence subscale (e.g., “I would rather depend on myself than others,” “I often do my own
thing”; 1 = strongly disagree, 7 = strongly agree) and the six-item interdependence subscale (e.g., “I feel good when I cooperate with my group members,” “I enjoy spending time with my group members”; 1 = strongly disagree, 7 = strongly agree) of the Personal Cultural Orientations Scale (Sharma, 2010). Then, we asked their prosocial intentions using five items (e.g., “I would give money to a charity,” “I would do volunteer work for a charity,” “I would stop an elevator and hold the door open for a stranger,” “I would donate blood,” “I would offer my seat on a bus or train to a stranger”; 1 = very unlikely, 7 = very likely) adapted from the Self-Report Altruism Scale (Rushton et al., 1981). Finally, participants reported their preference for bright colors, answered questions related to color blindness and demographics, and were dismissed.

10.2. Results and discussion

Manipulation checks. Participants’ responses to the two items (r = 0.735) were averaged to form a visual intensity manipulation check index. Those in the high-intensity condition (M = 5.13, SD = 1.13) perceived the stimuli’s color to be significantly more intense than those in the low-intensity one (M = 1.98, SD = 1.05; F(1, 137) = 290.57, p < .001).

Ego replenishment and prosocial intentions. We predicted a three-way interaction effect between social distancing, visual intensity, and interdependence on ego depletion, which influences prosocial intentions. We tested our hypothesis in a moderated mediation analysis using PROCESS Model 11 with social distancing as the independent variable (distancing = 1, control = 0) and prosocial intentions as the dependent variable. Visual intensity (high = 1, low = 0) and interdependence were used as the first and second moderators. Ego depletion, measured by the number of correct answers to the mental arithmetic questions, was the mediator. The interdependence index was created by subtracting the average of the six independence items (α = 0.622) from that of the six interdependence items (α = 0.660). The five prosocial intentions items were averaged to form the prosocial intention index (α = 0.600).

The index of moderated moderated mediation confirmed that the three-way interaction effect between social distancing, visual intensity, and interdependence on prosocial intentions mediated by ego depletion was significant (b = 0.19, 95% CI [0.010, 0.416]). The Johnson–Neyman technique revealed that at the 95% CI level, the interaction effect between high-intensity stimulation and social distancing on ego depletion was positive and significant for interdependence scores of 0.229 and above. The indices of conditional moderated mediation indicated a
positive and significant conditional indirect effect on prosocial intentions for interdependent participants ($b = 0.30, 95\% CI [0.018, 0.670]$), but not for independent ones ($b = -0.14, 95\% CI [-0.395, 0.049]$); see Figs. 8 & 9.

Discussion. The results of Study 4B revealed that socially distanced interdependent (vs. independent) individuals were more replenished by high-intensity visual stimulation during the pandemic, therefore showed more intentions to behave prosocially. The moderation effect of independent versus interdependent self-constructs suggests that social distancing may disrupt interpersonal contact, unlike other factors that could generate psychological distress such as health or financial worries.

11. Study 5

In Study 5, we conducted a field study with an opportunity for participants to donate money to a charity.

11.1. Method

Stimuli. The same two yellow-colored t-shirts used in Study 4A and 4B were used.

Procedure. A total of 193 university students in South Korea ($M_{\text{age}} = 21.59$ years; 124 females) participated in the experiment and were paid 10,000 Korean won (approximately US$8) for a 45-min session that included four studies, with this study being the last. After completing the third study, the students were asked to participate in a study on "T-shirt Design Evaluation." They were randomly assigned to one of two experimental conditions and asked to evaluate a t-shirt with high- or low-intensity color. Then, they completed the same intensity manipulation check questions similar to the previous studies. After the product evaluation task, they were told that the questionnaire was completed and they could indicate an amount to donate from their monetary compensation of 10,000 Korean won to one of the four listed charities: (1) "Relief funds for people affected by the outbreak of COVID-19" of the Korean Red Cross, (2) "COVID-19 Special fundraising for the underprivileged and medical volunteers" of Community Chest of Korea, (3) "Special fundraising for the underprivileged exposed to heatwaves" of the City of Seoul, and (4) "Relief activities to protect and support children" of UNICEF Korea. The charity choices were modeled after Google Adwords and were in the form of short messages and a URL (adapted from Sussman et al., 2015). After they indicated their intended donation amount, we measured their psychological distress during COVID-19 using one item ("I felt restricted by limited outside and physical activities,” 1 = not at all, 7 = very much). Finally, the participants provided some demographic information and were dismissed after giving them the remaining amount out of 10,000 Korean won.

11.2. Results

Manipulation checks. We averaged the participants' responses to the two-item manipulation check questions ($r = 0.741$) to create a visual intensity index. Participants perceived the stimuli’s color to be significantly more intense in the high-intensity condition ($M = 5.61, SD = 1.12$) than in the low-intensity one ($M = 2.35, SD = 1.23; F(1, 191) = 371.32, p < .001$).

Donation amount. Regression analysis revealed a significant two-way interaction effect between visual intensity (high = 1, low = 0) and psychological distress on donation amount ($b = 720.99, p = .039$). Specifically, exposure to high-intensity stimulation enhanced the donation amount for psychologically distressed participants ($+1\ SD: b = 1138.12, p = .047$). The Johnson–Neyman technique showed that at the 95\% CI level, the effect of high-intensity stimulation on donation amount was positive and significant for psychological distress scores of 6.94 and above.

12. Conclusion

The seven studies offer timely insight into prosocial behaviors during COVID-19. Our findings reveal that practicing strict social distancing requires extensive self-regulation. Those who practiced social distancing to a greater extent felt a stronger pandemic-induced psychological distress. We found that high-intensity visual stimulation boosted the psychologically distressed individuals’ prosocial intentions during social distancing (Studies 1, 3, and 4B). Furthermore, the mediating role of ego depletion as the underlying mechanism was identified using two separate analyses: one with ego depletion as a mediator preceding the high-intensity visual stimulation (Studies 2B, 4A, and 4B) and the other with a sense of richness and fullness of the intense color (sensory replenishment) as a mediator following the stimulation (Studies 2A and 3). This ego depletion and replenishment model reinforces our proposal that social distancing imposes self-regulation that, when practiced at a highly distressing level, depletes the energy resources needed for subsequent self-regulating behavior. Moreover, by manipulating social distancing, we established a causal link between social distancing and psychological distress (Study 4A) and a causal effect of the interaction between social distancing and visual stimulation on ego depletion (Study 4B). By manipulating psychological distress, we demonstrated a causal effect of the interaction between psychological distress and visual stimulation on ego depletion (Study 4B). We also showed that interdependence moderated the effect of social distancing on ego depletion induced by social distancing (Study 4B). Our results suggested that interdependent (vs. independent) individuals were more replenished by high-intensity visual stimulation. Finally, to show that high-intensity color influences psychologically distressed participants’ behavior, we presented an opportunity to the participants to donate money to real charities (Study 5).

This research contributes to the literature on the ongoing pandemic...
and its impact on society and consumers (Kirk & Rifkin, 2020). It provides important empirical findings regarding the effect of social distancing, one of the most significant societal changes brought by COVID-19, by conducting seven studies on the individuals currently experiencing it. While much literature has shown that the lack of social connections can lead to psychological distress, we did not find any study that examines the effects of high-intensity visual stimulation and ego replenishment regarding prosocial behavior during COVID-19.

The findings suggest that intense visual stimulation can be used in multiple ways to replenish energy lost from the prolonged pandemic situation. For example, cities could color public spaces in bright and saturated colors or install vivid artworks in these spaces. Medical fields could use intense colors in their art therapy programs for mental well-being. Companies could practice corporate social responsibility initiatives by manufacturing products in vivid colors.

This study also contributes to the existing literature on self-regulation in several ways. Specifically, we investigated self-regulatory behaviors in an uncontrolled, real-life situation of the global quarantine practices and examined their effects. Prior research has discussed ego depletion due to self-regulation and its effect on subsequent self-regulating tasks (Baumeister et al., 1998; Muraven & Baumeister, 2000). Extending these findings, this research identified some unique psychological outcomes driven by self-controlled behaviors, which deplete energy resources and affect subsequent behaviors.

Our findings also enrich the literature on the effect of sensory stimulation, specifically high-intensity visual stimulation. This research tested the effect of intense visual stimulation using various color hues (e.g., yellow, green, orange, and blue), an extension of the previous research that demonstrated only orange hues’ effect (Batra & Ghoshal, 2017). Moreover, our work shows that sensory input is associated with abstract concepts and expectable consequences (Landau et al., 2010; Batra & Ghoshal, 2017) by demonstrating how intense visual stimuli symbolic of richness and fullness can be associated with replenishment. This mental association then causes behavioral consequences, increasing prosocial behaviors that require self-regulatory resources.

This research addressed the varying degrees of social distancing practices, from stringent quarantine measures to less strict government guidelines as all-inclusive “social distancing” practices. Future research could investigate how different forms and extents of COVID-19 restrictions (e.g., mandatory quarantine vs. minor distancing suggestions) have different effects on individuals regarding self-control and ego depletion.

This research is among the first to attempt an empirical study on the unique psychological consequences of social distancing during this pandemic leading to ego depletion, and replenishment through sensory stimulation, with limited prior research for appropriate scales to refer to. Future research could examine the robustness of the psychological distress and sensory replenishment constructs used in this research’s studies. The psychological distress caused by social distancing and the ego-replenishing effect of intense colors can be examined using a physiological measure. Moreover, Study 5 was a field study including only one measure for psychological distress and participants were depleted by preceding studies. Hence, future research could examine the interaction effect between visual intensity and psychological distress on prosocial behavior using more elaborate designs.

**CRediT authorship contribution statement**

Y. Park and N. Youn

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Appendix A. Study stimuli**

**Study 1**

| High-Intensity Condition | Low-Intensity Condition |
|--------------------------|-------------------------|
| Bright-green cushion     | Dull-green cushion       |
| HEX #7F8D01; R173 G187 B1; H69 S252 L94* | HEX #7F7F7F; R128 G128 B128 |
| Bright-orange notebook   | Dull-orange notebook     |
| HEX #A3B7994; R163 G185 B148; H68 S53 L167 | HEX #A3B7994; R163 G185 B148; H68 S53 L167 |

(continued on next page)
High-Intensity Condition | Low-Intensity Condition
---|---
![](bright-blue-smartphone-case.png) | ![](dull-blue-smartphone-case.png)
**HEX #EC5F00; R236 G95 B0; H17 S255 L118** | **HEX #ECA678; R236 G166 B120; H17 S192 L178**
Bright-blue smartphone case | Dull-blue smartphone case

**Study 2A**

| High Intensity | Low Intensity |
|---|---|
| ![](bright-green-cushion.png) | ![](dull-green-cushion.png) |
**HEX #0009FF; R0 G9 B255; H169 S255 L128** | **HEX #C8C9FF; R200 G201 B255; H169 S255 L228**
Bright-green cushion | Dull-green cushion

* RGB color system is a widely known commercial color order system based on increments of the intensity of three primary lights—red, green, and blue. We included RGB values for the color stimuli so that they can be easily replicated in display systems using widely used software such as Microsoft PowerPoint. HEX refers to the hexadecimal code used by webpages to set colors. R refers to red value, G refers to green value, and B refers to blue value. Regarding color properties, H refers to hue, S refers to saturation, and L refers to lightness.

**Study 2B**

| High-Intensity Condition | Low-Intensity Condition |
|---|---|
| Bright-green cushion | Dull-green cushion |
(continued on next page)
### Study 3

| High-Intensity Condition | Low-Intensity Condition |
|-------------------------|------------------------|
| ![Bright-orange notebook](image1.png) **HEX #43BC00; R67 G188 B0; H70 S255 L94** | ![Dull-orange notebook](image2.png) **HEX #587448; R88 G116 B72; H70 S60 L94** |
| ![Bright-blue smartphone case](image3.png) **HEX #FF7D25; R255 G125 B37; H17 S255 L146** | ![Dull-blue smartphone case](image4.png) **HEX #A78E7D; R167 G142 B125; H17 S49 L146** |
| ![Bright-orange notebook](image5.png) **HEX #0009FF; R0 G9 B255; H169 S255 L128** | ![Dull-orange notebook](image6.png) **HEX #676899; R103 G104 B153; H169 S50 L128** |
(continued)

### Study 4

| High-Intensity Condition | Low-Intensity Condition |
|-------------------------|------------------------|
| ![image1]               | ![image2]              |

| HEX #FFBD11; R255 G189 B17; H30 S255 L136 | HEX #9F9271; R159 G146 B113; H30 S49 L136 |

| HEX #FFB001; R255 G176 B1; H29 S255 L128 | HEX #998A67; R153 G138 B103; H29 S50 L128 |

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