

The Impact of Perceived Robot Threat on Workplace Objectification

Authors: Xu Liying, Wang Xuehui, Feng Yu, Peng Kaiping, Yu Feng

Date: 2023-03-04T00:00:00+00:00

Abstract

Amidst the prevalence of workplace colloquialisms such as “tool person,” “wage worker,” and “corporate livestock,” workplace objectification has emerged as a phenomenon warranting attention. Moreover, as the deployment of artificial intelligence, particularly robots, in workplace settings continues to proliferate, their occupational effects merit systematic investigation. The present research aims to examine whether perceived robot threat in today’s rapidly advancing AI society can generate or exacerbate workplace objectification. Eight progressive sub-studies ($N = 3422$) investigated the impact of perceived robot threat on workplace objectification and explored its underlying mechanisms and boundary conditions. The findings indicate: First, perceived robot threat increases individuals’ tendency to objectify others in the workplace, with perceived robot identity threat (i.e., threat to human uniqueness) exerting a stronger effect; Second, sense of control mediates the relationship between perceived robot threat (primarily identity threat) and workplace objectification, such that higher perceived robot identity threat predicts lower sense of control, which in turn leads to more severe workplace objectification; Third, three alternative compensatory control strategies—namely, strengthening personal agency, supporting external agency, and affirming specific structures—moderate the effect of perceived robot threat on workplace objectification. These results illuminate the negative interpersonal consequences of robots and their psychological mechanisms, offering insights for understanding, anticipating, and addressing the adverse societal outcomes of robotic integration.

Full Text

The Influence of Perceived Robot Threat on Workplace Objectification

XU Liying^{1,2†}, WANG Xuehui^{3†}, YU Feng⁴, PENG Kaiping³

¹ Moral Education Research Center, Tsinghua University, Beijing 100084, China

² School of Marxism, Tsinghua University, Beijing 100084, China

³ Department of Psychology, School of Social Sciences, Tsinghua University, Beijing 100084, China

⁴ Department of Psychology, School of Philosophy, Wuhan University, Wuhan 430072, China

Supported by the National Natural Science Foundation of China Youth Project (72101132) and the National Social Science Fund Youth Project (20CZX059).

† XU Liying and WANG Xuehui are co-first authors.

Corresponding author: YU Feng, E-mail: psychpedia@whu.edu.cn

Abstract

With buzzwords such as “tool person,” “wage earner,” and “corporate livestock” sweeping through modern workplaces, workplace objectification has become an issue demanding urgent attention. As artificial intelligence, particularly robots, becomes increasingly prevalent in professional settings, their workplace effects warrant careful investigation. This research aims to explore whether perceived threats from robots in today’s rapidly developing AI society produce or exacerbate workplace objectification. Eight sequential sub-studies ($N = 3,422$) examined the impact of perceived robot threat on workplace objectification and explored its underlying mechanisms and boundary conditions. The findings reveal: First, perceiving robot threat increases individuals’ tendency to objectify others in the workplace, with perceived robot identity threat (i.e., threat to human uniqueness) producing stronger effects. Second, sense of control mediates the relationship between perceived robot threat (primarily identity threat) and workplace objectification—higher perceived robot identity threat leads to lower sense of control, which in turn intensifies workplace objectification. Third, three alternative compensatory control strategies—strengthening personal agency, supporting external agency, and affirming specific structure—moderate the effect of perceived robot threat on workplace objectification. These results reveal the negative interpersonal consequences of robots and their psychological mechanisms, contributing to better understanding, early warning, and management of robots’ adverse societal outcomes.

Keywords: workplace objectification, perceived robot threat, realistic threat, identity threat, compensatory control theory

1. Introduction

Workplace objectification is not uncommon, as evidenced by the popularity of terms like “tool person,” “wage earner,” and “corporate livestock.” Objectification originates from Kant’s description of “reducing a person, a human being, to the status of a thing (Kant, 1797/1996, p. 209).” Martha Nussbaum further developed this concept, characterizing it through seven dimensions: instrumentality, denial of autonomy, inertness, fungibility, violability, ownership, and denial of

subjectivity (Nussbaum, 1995, 1999). Among these, instrumentality represents the core of objectification (Orehek & Weaverling, 2017) and has been widely studied (e.g., Calogero, 2013; Gervais et al., 2014). At its essence, objectification involves treating people (others or oneself) as tools for achieving goals, denying their humanity, and consequently dealing with them as one would with objects (Xu et al., 2022). While research on objectification has primarily focused on sexual objectification (e.g., Alexander et al., 2015; Calogero, 2013; Saguy et al., 2010; Skowronski et al., 2021), the targets of objectification are clearly not limited to women. Workplace objectification represents another important domain, referring to the process and tendency to treat people as objects in work settings, primarily reflecting instrumentality in work relationships and the denial of humanity (Baldissarri et al., 2014; Belmi & Schroeder, 2021; Xu et al., 2022). It constitutes a negative interpersonal interaction pattern and form of instrumental rationality.

Factors influencing workplace objectification include individual-related aspects such as power (Gruenfeld et al., 2008) and work-related aspects such as job repetitiveness (Baldissarri et al., 2017) and workplace anonymity (Taskin et al., 2019). Workplace objectification is typically measured through explicit methods (e.g., questionnaires; Belmi & Schroeder, 2021) and implicit methods (e.g., IAT; Baldissarri et al., 2017). Workplace objectification reflects the alienation phenomenon in modern work (Marx, 1844/1964). Since the Industrial Revolution, productivity has developed dramatically, making division of labor possible. Individuals have transformed from human beings into “workers” in the workplace, with each person becoming a “cog” in the social division of labor. When human labor shifts from instinct to tool, and people are measured by the value they produce, alienation emerges and humans become tools (Marx, 1844/1964).

With the rise of artificial intelligence technology permeating daily life, robots have entered the workplace alongside humans, either assisting decision-making through programs or providing physical assistance through embodied forms (Zhang et al., 2022). As human-robot relationships evolve and the boundary between humans and machines becomes increasingly blurred, might this lead people to objectify others even more? If so, this warrants concern. The development of robot labor may lead people to rationalize the belief that “humans can be treated as tools” —that is, objectification (e.g., Pew Research Center, 2017). Robots can be categorized into two main types: industrial robots and service robots. Industrial robots are defined as “automatically controlled, re-programmable, multipurpose manipulators programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications” (ISO 8373:2012), while service robots are “robots that perform useful tasks for humans or equipment, excluding industrial automation applications” (ISO 8373:2012). The workplace robots in this study include both industrial and service robots—various physical robots that appear in workplace environments and work alongside humans.

The widespread use of workplace robots threatens human employment and

safety, as well as human identity and uniqueness (Yogeeswaran et al., 2016). After all, as human-made objects, even if robots' intelligence eventually matches or exceeds humans, they are more likely to be treated as another entity and become an outgroup for humans. Intergroup threat theory (Stephan et al., 2015) suggests that outgroups generate realistic threat and symbolic threat. The former involves resource threats, including physical harm to the ingroup and threats to the ingroup's power, resources, and well-being, while the latter refers to threats to ingroup identity, values, and uniqueness (Stephan et al., 2015). Realistic threat is self-evident: robots are easier to manage and more cost-effective (Borenstein, 2011). They require neither complex interpersonal coordination nor wages beyond purchase and maintenance costs, and can even work longer hours (McClure, 2018). Robot substitution affects technical and manual labor more than creative work, with older, less educated, and less adaptable workers being more vulnerable to replacement (Borenstein, 2011). Beyond job displacement, robots may also create realistic threats through safety concerns during human-robot interaction (Murashov et al., 2016). More importantly, robots' capabilities and human-like appearance create identity threat (i.e., symbolic threat in intergroup threat theory). Robots' computational and load-bearing capabilities already surpass humans, causing cognitive dissonance regarding defining human characteristics (Yu, 2020). Simultaneously, robots' appearance can be nearly indistinguishable from humans, and the blurring boundary between humans and humanoid robots necessitates an anthropomorphization process (Xu et al., 2017; Yu & Xu, 2020) that threatens human uniqueness.

When robots enter the workplace, making people perceive realistic and identity threats, individuals may lose their sense of control. Maintaining and strengthening control represents a primary response to threat (Greenaway et al., 2014). The threat orientation model has already demonstrated that lack of perceived control is an inevitable consequence of experiencing threat (Thompson & Schlehofer, 2008). Gaining control over oneself and the external world constitutes a fundamental psychological need, and humans are motivated to control their own lives (Landau et al., 2015). Once sense of control is impaired, people strive to compensate. Compensatory control theory (Kay et al., 2008; Kay et al., 2009; Landau et al., 2015) posits that people adopt compensatory strategies in response to events and cognitions that reduce sense of control, intending to restore control to baseline levels. But how do they compensate? One strategy involves seeking and preferring simple, clear, and consistent explanations of the world. Objectification involves ignoring others' complex beliefs, desires, and mental activities, reducing them to concrete objects, thereby enabling simple, clear, and consistent explanations of others' subjective states and the external objective world, which produces control compensation. Research has found that when men feel they lack influence over women, they are more likely to objectify women, and subsequent workplace research has found that participants who doubted their ability to influence colleagues were more likely to objectify them (Landau et al., 2012). This control compensation strategy is called affirming nonspecific structure.

Based on this, robot labor creates realistic and identity threats for humans, and these two types of perceived robot threat lead to reduced sense of control. To compensate for sense of control, people engage in workplace objectification by affirming nonspecific structure. Of course, affirming nonspecific structure is considered relative to three other compensatory control strategies: strengthening personal agency, supporting external agency, and affirming specific structure (Landau et al., 2015). Affirming specific structure refers to people's tendency to believe that specific behaviors can reliably produce expected outcomes, with this clear path from behavior to results being specific to the context where perceived control is reduced. For example, if people adopt an affirming specific structure strategy to compensate for perceived control when sensing robot threat, they might believe in a robot-specific "behavior—outcome" connection, such as believing that unplugging a robot (behavior) will definitely control it (result). Specific structure refers to the robot itself, whereas objectifying humans represents affirming nonspecific structure—that is, not directly targeting the robot that poses the threat. Strengthening personal agency refers to "the belief that one possesses the necessary resources to perform one or a set of behaviors required to produce specific results or achieve specific goals" (Landau et al., 2015), such as affirming one's own resources and abilities to control robots, believing oneself to be more capable than robots and able to direct them to do assigned work. Supporting external agency indicates that individuals can rely on systems beyond the self, such as delegating personal agency to God or government, believing that external systems will mobilize resources to achieve individual goals, thereby regaining control. In other words, people may also increase support for government or faith in God when perceiving robot threat, believing that the government or God can control robots and protect them. Affirming nonspecific structure differs from these three strategies in that it does not directly address beliefs about personal resources or beliefs about external systems; instead, it targets aspects of the social and physical environment that fall outside the specific context where perceived control is reduced (Xu et al., 2022). However, because these three alternative compensatory control strategies or beliefs can still restore sense of control impaired by perceived robot threat, they should moderate the outcome of workplace objectification resulting from perceived robot threat.

Although deriving the effect of perceived robot threat on workplace objectification through the social identity pathway is logical, and it is intuitively known that threat negatively impacts interpersonal relationships (Xu et al., 2022)—that is, threat produces negative interpersonal outcomes, such as increased material insecurity leading to greater perceived threat from immigrants and foreign workers and increased support for anti-immigration policies (e.g., Frey et al., 2018; Im et al., 2019)—controversy remains regarding robots. For example, some studies have found that robot labor, as an outgroup, can highlight humans' common identity, thereby reducing prejudice toward human outgroups (Jackson et al., 2020). Interestingly, in the same study, data collected from 37 countries showed that countries with the fastest automation growth over the past 42 years also

showed increased explicit prejudice toward outgroups, an effect partly related to rising unemployment (Jackson et al., 2020). This indirectly suggests that robots may negatively impact interpersonal relationships through threats such as unemployment. Therefore, this paper's exploration of perceived robot threat's effect on workplace objectification contributes to better understanding workplace objectification as a hot social issue and core research topic in the context of rapidly developing AI (Xu et al., 2022), while also addressing the controversial question of how AI affects interpersonal relationships and providing early warning about real-world problems by focusing on robots' negative workplace impacts.

This paper comprises three sequential studies. The basic hypothesis is that perceived robot threat increases workplace objectification toward colleagues, with control compensation (sense of control) as the mediating mechanism and other compensation strategies moderating this effect. Study 1 uses two sub-studies to explore whether perceived robot threat increases workplace objectification, testing this phenomenon in real-world and online settings to demonstrate robustness while excluding the role of common human identity (panhumanism). Study 2 includes three sub-studies investigating why perceived robot threat increases workplace objectification, verifying the mediating mechanism of control compensation, explaining the phenomenon's causes, and validating it through different operational methods. Study 3 includes three sub-studies that, based on the three compensatory control strategies proposed by compensatory control theory, examine the boundary conditions of this phenomenon by treating personal agency, external agency, and specific structure beliefs as moderating variables.

2. Study 1: The Relationship Between Perceived Robot Threat and Workplace Objectification

Study 1 comprises two sub-studies demonstrating the preliminary relationship between perceived robot threat and workplace objectification. Study 1.1 uses a high-ecological-validity sample from actual robot companies to establish preliminary correlational evidence, while Study 1.2 employs experimental manipulation of the independent variable to examine causal relationships and rule out panhumanism effects.

2.1.1 Participants

Data were collected on-site from three well-known robot companies. The study recruited 1,587 participants. After excluding 361 individuals who did not complete the survey or failed attention checks, the final valid sample consisted of 1,226 participants, including 830 males (67.7%) and 396 females (32.3%), with a mean age of 31.38 ± 7.01 years. All participants voluntarily participated and provided informed consent.

2.1.2 Measures

Perceived Robot Threat. We adopted the Perceived Robot Threat Scale developed by Yogeeswaran et al. (2016). This scale comprises two dimensions: perceived robot realistic threat and perceived robot identity threat, with five items each. Perceived robot realistic threat items include: (1) “The increasing use of robots in our daily lives is causing human unemployment” ; (2) “Robots cannot replace people’s jobs” ; (3) “In the long run, robot development poses a direct threat to human safety and well-being” ; (4) “The development of robot technology threatens human employment and opportunities” ; (5) “The increasing popularity of robots in daily life poses a threat to human safety.” Item 2 is reverse-scored. Perceived robot identity threat items include: (1) “The widespread application of robots in daily life troubles me because it blurs the boundary between humans and machines” ; (2) “Lifelike robots are disturbing because they are almost indistinguishable from humans” ; (3) “Recent technological advances challenge the essence of humanity” ; (4) “Technological advances in robotics are threatening human uniqueness” ; (5) “Robots are beginning to blur the boundary between humans and machines.” The scale uses a 7-point Likert format (1 = strongly disagree, 7 = strongly agree). In this study, Cronbach’s α was 0.80 for the realistic threat dimension and 0.84 for the identity threat dimension.

Workplace Objectification. Based on Belmi and Schroeder (2021), we modified the scale by changing the target to “colleagues.” The scale contains seven items encompassing Nussbaum’s (1999) seven dimensions of objectification. Modified items include: (1) “Whether I value a colleague depends mainly on what he/she can do for me” ; (2) “I rarely pay attention to colleagues’ hopes and wishes” ; (3) “I think colleagues are replaceable to me” ; (4) “I would force colleagues to do what I want them to do” ; (5) “I would treat colleagues as a tool” ; (6) “I would care about colleagues’ feelings because I really care about his/her personality” ; (7) “Even if colleagues disagree with me, I will continue with my own plans.” Item 6 is reverse-scored. The scale uses a 7-point Likert format (1 = strongly disagree, 7 = strongly agree). Cronbach’s α was 0.71 in this study.

To enhance result robustness, the following control variables were included: (1) presence of robots in the workplace (yes/no); (2) average daily interaction time with robots (in hours); (3) familiarity with robots (Leo & Huh, 2020): “How familiar are you with robots?” (1 = not at all, 5 = very much) and “Compared with average Chinese people, how knowledgeable do you think you are about robots?” (1 = not at all, 5 = very much); (4) subjective social status (Adler et al., 2000). Demographic variables including gender, age, position, education, and company were also collected.

2.1.3 Control and Assessment of Common Method Bias

This study controlled common method bias procedurally through anonymous data collection and reverse-scored items (Zhou & Long, 2004). Harman's single-factor test was used to assess common method bias. Unrotated exploratory factor analysis extracted three factors with eigenvalues greater than 1, with the largest factor explaining 31.22% of variance (less than 40%), indicating no serious common method bias.

2.1.4 Results

Workplace objectification was significantly positively correlated with perceived robot realistic threat ($r = 0.15, p < 0.001$) and perceived robot identity threat ($r = 0.18, p < 0.001$). After controlling for gender, age, presence of robots in the workplace, interaction time, robot familiarity, and subjective social status, workplace objectification remained significantly positively correlated with both perceived robot realistic threat ($r = 0.16, p < 0.001$) and identity threat ($r = 0.20, p < 0.001$).

2.2.1 Participants

We used G*Power 3.1 to determine the required sample size. Based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor two-level between-subjects design required 266 participants to achieve 90% statistical power. Because the study investigated workplace objectification, we set the participation criterion as currently employed. Considering that attention checks would exclude some participants, we recruited 507 participants through the Credamo platform. After 106 participants failed attention checks, the final sample consisted of 401 participants (Mage = 29.41, SD = 5.24; 201 females, 50.1%).

2.2.2 Procedure

This study employed a single-factor two-level between-subjects design. Participants were randomly assigned to either the high perceived robot threat group (94 males, 96 females) or the low perceived robot threat group (106 males, 105 females). Following previous research (Jackson et al., 2020), we created two different news webpage images. As shown in [Figure 1: see original paper], participants in the high threat group read a technology news article titled "Robots: Replacing Human Labor?" describing how robots are increasingly taking human jobs. Participants in the low threat group read an article titled "Robots: Just a Passing Fad?" describing how robots will never replace most human jobs. Both webpages had identical layouts, lengths, and formats. After viewing the materials, participants completed the robot threat scale as a manipulation check (same as Study 1.1; Cronbach's $\alpha = 0.85$ for realistic threat, 0.89 for identity threat).

[Figure 1: see original paper] Manipulation materials for perceived robot threat

Before the experiment, we selected three different office scenarios and had different men and women photographed in these settings, creating six employee work photos (see [Figure 2: see original paper], authorized for use). Researchers told participants this was a “social perception study” in which they would view a technology news article and some photos. Participants were asked to imagine working with the people shown in the photos (i.e., the photos showed their colleagues). The six photos were presented in random order, and participants completed a questionnaire after viewing each photo (workplace objectification measure same as Study 1.1; Cronbach’s $\alpha = 0.88$ after averaging scores across six photos), repeating this process until all six photos were evaluated.

[Figure 2: see original paper] Workplace objectification target photo materials

Next, participants completed the panhumanism measure using McFarland, Webb, and Brown’s (2012) scale. Participants were shown six sets of diagrams, each containing two circles with varying degrees of overlap. One circle represented “self” and the other “humanity.” Participants selected the diagram that best represented how they viewed the relationship between themselves and all humanity. For example, selecting two completely separate circles indicated viewing oneself as isolated from humanity, while selecting completely overlapping circles indicated extreme identification with all other humans.

Participants then completed control variables. Unlike Study 1.1, this study used photo materials as imagined work scenarios and objectification targets, so it did not involve controlling for specific job attributes or workplace environments. Following previous workplace objectification research (Belmi & Schroeder, 2021), main control variables included power and characteristics of people in photos: (1) personal power: “This photo makes me feel powerful” (1 = strongly disagree, 7 = strongly agree); (2) social class: “What social class do you think the person in this photo belongs to?” (1 = low, 7 = high); (3) attractiveness: “How physically attractive do you think the person in this photo is?” (1 = not at all, 7 = very much); (4) respect: “Generally, do you think people would respect the person in this photo?” (1 = definitely not, 7 = definitely yes); (5) target power: “How powerful do you think the person in this photo is?” (1 = not at all, 7 = very much); (6) liking: “Just by looking at the person in this photo, how much do you like him/her?” (1 = not at all, 7 = very much).

Attention checks were then administered. Two attention check items were embedded in the scales (e.g., “For this question, please select ‘strongly agree’”). Additionally, content-based attention checks assessed the manipulation materials: (1) “According to the research, the proportion of jobs currently occupied by robots is (1 = large, 2 = small)”; (2) “According to the study’s authors, the time required for advances in robot capabilities and intelligence will be (1 = longer, 2 = shorter) than expected.”

Finally, participants provided demographic information: age, gender, education, annual income, position level, and organization type.

2.2.3 Results

One-way ANOVA revealed that the high perceived robot threat group reported significantly higher realistic threat ($M = 4.69$, $SD = 0.99$) than the low threat group ($M = 3.10$, $SD = 0.98$), $F(1, 399) = 260.72$, $p < 0.001$, $\eta^2_p = 0.40$. The high threat group also reported significantly higher identity threat ($M = 4.43$, $SD = 1.26$) than the low threat group ($M = 3.22$, $SD = 1.19$), $F(1, 399) = 97.31$, $p < 0.001$, $\eta^2_p = 0.20$, indicating successful manipulation.

One-way ANOVA showed that workplace objectification was significantly higher in the high threat group ($M = 3.54$, $SD = 1.01$) than in the low threat group ($M = 3.32$, $SD = 0.92$), $F(1, 399) = 4.94$, $p = 0.027$, $\eta^2_p = 0.01$. This result remained robust after controlling for participants' gender, age, and annual income: the high threat group ($M = 3.53$, $SD = 1.01$) still showed significantly higher workplace objectification than the low threat group ($M = 3.32$, $SD = 0.92$), $F(1, 395) = 5.19$, $p = 0.023$, $\eta^2_p = 0.01$. After further adding power as a control variable, the high threat group ($M = 3.53$, $SD = 1.01$) continued to show significantly higher workplace objectification than the low threat group ($M = 3.32$, $SD = 0.92$), $F(1, 394) = 6.02$, $p = 0.015$, $\eta^2_p = 0.02$. Finally, after adding evaluations of people in photos as control variables, the high threat group ($M = 3.53$, $SD = 1.01$) still demonstrated significantly higher workplace objectification than the low threat group ($M = 3.33$, $SD = 0.92$), $F(1, 389) = 4.01$, $p = 0.046$, $\eta^2_p = 0.01$.

Panhumanism analysis revealed no significant difference between the high threat group ($M = 4.32$, $SD = 1.14$) and low threat group ($M = 4.28$, $SD = 1.11$), $F(1, 399) = 0.10$, $p = 0.748$, $\eta^2_p < .001$. Moreover, after controlling for panhumanism, the high threat group ($M = 3.54$, $SD = 1.01$) still showed significantly higher workplace objectification than the low threat group ($M = 3.33$, $SD = 0.92$), $F(1, 389) = 4.88$, $p = 0.028$, $\eta^2_p = 0.01$.

3. Study 2: The Mediating Role of Sense of Control

Study 2 comprises three sub-studies. Study 2.1 uses a questionnaire approach to examine sense of control's mediating role in the effect of both dimensions of perceived robot threat (realistic and identity threat) on workplace objectification. Study 2.2 replicates this mediating effect through experimental manipulation of perceived robot threat (without distinguishing dimensions). Study 2.3 separately activates robot realistic threat and robot identity threat to examine which threat condition sense of control mediates.

3.1.1 Participants

We used G*Power 3.1 software (Faul et al., 2007) to determine the required sample size. For the correlation analysis used in this study, based on Study 1's correlation results, we assumed a small effect size $d = 0.16$, significance level $\alpha = 0.05$, requiring at least 402 participants to achieve 90% statistical power. Considering potential dropouts and attention check failures, we recruited 480 undergraduate students from two universities who received course credit for participation. Participants completed online questionnaires through the Qualtrics platform after reading instructions and providing informed consent. Ultimately, 75 participants failed to complete the study or failed attention checks, yielding 405 valid responses (213 females, 52.6%; $M_{age} = 18.75$, $SD = 1.61$).

3.1.2 Procedure

Perceived Robot Threat (Cronbach's $\alpha = 0.67$ for realistic threat, 0.81 for identity threat) and **Workplace Objectification** (Cronbach's $\alpha = 0.71$) measures were identical to Study 1.1, except that for the workplace objectification measure, undergraduate participants received the instruction: "Please imagine you have graduated and entered a company where you have many colleagues. Please indicate your agreement with the following statements."

Sense of Control was measured using the Chinese revised version of Lachman and Weaver's (1998) Sense of Control Scale (Yang et al., 2016). This scale comprises two additive dimensions: mastery (4 items) and constraints (8 items, reverse-scored), totaling 12 items. Mastery items include: (1) "I can do just about anything I really set my mind to"; (2) "When I really want to do something, I can usually find a way to succeed"; (3) "Whether or not I can get what I want is in my own hands"; (4) "My future depends mainly on myself." Constraint items include: (1) "What happens in my life is often beyond my control"; (2) "There is little I can do to change many important things in my life"; (3) "I often feel helpless in dealing with problems in my life"; (4) "I have little control over things that happen to me"; (5) "When I want to do something, other things always interfere"; (6) "I almost cannot control what happens to me"; (7) "I really have no way to solve all my problems"; (8) "Sometimes I feel pushed around in life." The scale uses a 7-point Likert format (1 = strongly disagree, 7 = strongly agree), with higher scores indicating greater sense of control. Cronbach's α for all items was 0.83. Attention check items were embedded throughout, followed by demographic questions.

3.1.3 Control and Assessment of Common Method Bias

This study controlled common method bias procedurally through anonymous data collection and reverse-scored items (Zhou & Long, 2004). Harman's single-factor test extracted eight factors with eigenvalues greater than 1, with the largest factor explaining 16.75% of variance (less than 40%), indicating no serious common method bias.

3.1.4 Results

Correlation analysis showed that workplace objectification was significantly positively correlated with perceived robot threat and both its dimensions ($r_{\text{realistic}} = 0.12$, $p = 0.017$; $r_{\text{identity}} = 0.18$, $p < 0.001$). Workplace objectification was significantly negatively correlated with sense of control and both its dimensions ($r_{\text{control}} = -0.12$, $p = 0.020$; $r_{\text{mastery}} = -0.12$, $p < 0.001$; $r_{\text{constraints}} = -0.23$, $p < 0.001$). Perceived robot identity threat was significantly negatively correlated with sense of control ($r = -0.11$, $p = 0.025$), while perceived robot realistic threat showed a non-significant negative correlation with sense of control ($r = -0.07$, $p = 0.152$).

To test whether sense of control mediates the effect of perceived robot identity threat on workplace objectification, we conducted a bias-corrected bootstrap test using SPSS PROCESS (Hayes et al., 2013), Model 4, with 5,000 resamples. In the 95% confidence interval, with perceived robot identity threat as the independent variable, workplace objectification as the dependent variable, and sense of control as the mediator, mediation analysis showed that the 95% bootstrap confidence interval did not include zero. Thus, sense of control mediated the effect of perceived robot identity threat on workplace objectification (indirect effect = 0.02, SE = 0.01, 95% CI [0.002, 0.038]). After controlling for sense of control, the direct effect of perceived robot identity threat on workplace objectification remained significant (direct effect = 0.11, SE = 0.03, 95% CI [0.042, 0.170]), indicating partial mediation.

3.2.1 Participants

We used G*Power 3.1 to determine the required sample size. Based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor two-level between-subjects design required 266 participants to achieve 90% statistical power. Because the study investigated workplace objectification, we set the participation criterion as currently employed. Considering attention check exclusions, we recruited 359 participants through Credamo. After 62 participants failed attention checks, the final sample consisted of 297 participants (Mage = 31.52, SD = 5.68; 184 females, 62.0%).

3.2.2 Procedure

This study used a single-factor two-level between-subjects design. Participants were randomly assigned to high or low perceived robot threat groups, with 148 in the high threat group and 149 in the low threat group. Experimental materials manipulating perceived robot threat were identical to Study 1.2. After viewing materials, participants completed the robot threat scale as a manipulation check (same as Study 1.1; Cronbach's $\alpha = 0.92$ for realistic threat, 0.92 for identity threat), followed by sense of control measurement (same as Study 2.1; Cronbach's $\alpha = 0.91$ for all items) and workplace objectification measurement (same

as Study 1.1; Cronbach's $\alpha = 0.80$). Attention check items were embedded throughout, followed by demographic questions.

3.2.3 Results

One-way ANOVA showed that the high threat group reported significantly higher perceived robot realistic threat ($M = 4.83$, $SD = 1.11$) than the low threat group ($M = 2.83$, $SD = 1.14$), $F(1, 295) = 210.81$, $p < 0.001$, $\eta^2_p = 0.42$. The high threat group also reported significantly higher identity threat ($M = 4.49$, $SD = 1.37$) than the low threat group ($M = 2.91$, $SD = 1.25$), $F(1, 295) = 108.42$, $p < 0.001$, $\eta^2_p = 0.27$, indicating successful manipulation.

One-way ANOVA revealed that workplace objectification was significantly higher in the high threat group ($M = 2.85$, $SD = 0.90$) than in the low threat group ($M = 2.64$, $SD = 0.65$), $F(1, 295) = 5.49$, $p = 0.020$, $\eta^2_p = 0.02$. Correlation analysis showed that perceived robot threat level (low threat = 0, high threat = 1) was significantly negatively correlated with sense of control ($r = -0.14$, $p = 0.018$) and significantly positively correlated with workplace objectification ($r = 0.14$, $p = 0.020$). Sense of control was significantly negatively correlated with workplace objectification ($r = -0.50$, $p < 0.001$).

To test whether sense of control mediates the effect of perceived robot threat on workplace objectification, we conducted a bias-corrected bootstrap test using SPSS PROCESS (Hayes et al., 2013), Model 4, with 5,000 resamples. In the 95% confidence interval, with perceived robot threat as the independent variable (low threat = 0, high threat = 1), workplace objectification as the dependent variable, and sense of control as the mediator, mediation analysis showed that the 95% bootstrap confidence interval did not include zero. Thus, sense of control mediated the effect of perceived robot threat on workplace objectification (indirect effect = 0.11, $SE = 0.05$, 95% CI [0.020, 0.228]). After controlling for sense of control, the direct effect of perceived robot threat on workplace objectification was no longer significant (direct effect = 0.11, $SE = 0.08$, 95% CI [-0.051, 0.266]), indicating full mediation.

3.3.1 Participants

We used G*Power 3.1 to determine the required sample size. Based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor three-level between-subjects design required 321 participants to achieve 90% statistical power. Because the study investigated workplace objectification, we set the participation criterion as currently employed. Considering attention check exclusions, we recruited 359 participants through Credamo. After 10 participants failed attention checks, the final sample consisted of 349 participants ($Mage = 31.49$, $SD = 7.14$; 196 females, 56.2%).

3.3.2 Procedure

This study used a single-factor three-level between-subjects design. Participants were randomly assigned to realistic threat, identity threat, or control groups, with 115 in the realistic threat group, 117 in the identity threat group, and 117 in the control group.

To manipulate perceived robot threat, participants first completed a writing task based on specific instructions:

Realistic Threat Group Instructions:

“With the rapid development of artificial intelligence, over 50% of jobs across all industries have already been occupied by robots. In the future, robots will inevitably compete with humans as new workers, posing real-life threats. Soon, robots will be competent in more high-level jobs, entering all areas of human work, ultimately replacing many jobs people currently hold, creating greater realistic threats. Please imagine and describe how your current job position is now or will be threatened and replaced by robots, and what situation you will face after being threatened and replaced (no less than 100 words).”

Identity Threat Group Instructions:

“With the rapid development of artificial intelligence, robots are becoming increasingly similar to humans, making it difficult to distinguish between humans and machines. In appearance, many robots are highly similar to humans, looking almost identical to real people and even difficult to distinguish; in capability, many robots’ abilities are comparable to or exceed humans, threatening human uniqueness. AI technology will also combine humans and machines, making it difficult to define what is human and what is robot in the future. Please imagine and describe how a robot highly similar to or indistinguishable from humans threatens your uniqueness as a human being, and what situation you will face after being threatened (no less than 100 words).”

Control Group Instructions:

“With the development of artificial intelligence, machines will assist humans in many social activities. Please imagine and describe a future scenario where robots assist humans (no less than 100 words).”

After the writing task, participants completed the perceived robot threat scale (same as Study 1.1; Cronbach’s $\alpha = 0.82$ for realistic threat, 0.88 for identity threat), sense of control questionnaire (same as Study 2.1; Cronbach’s $\alpha = 0.90$ for all items), and workplace objectification scale (same as Study 1.1; Cronbach’s $\alpha = 0.77$). Attention check items (e.g., “For this question, please select ‘strongly disagree’ ”) were embedded throughout, followed by demographic questions.

3.3.3 Results

Using group (control = 1, realistic threat = 2, identity threat = 3) as the independent variable and perceived robot realistic threat as the dependent variable, one-way ANOVA revealed a significant main effect, $F(2, 346) = 44.35$, $p <$

0.001, $\eta^2_p = 0.20$. Post-hoc Bonferroni comparisons showed that the control group's realistic threat rating ($M = 3.70$, $SD = 0.99$, 95% CI [3.52, 3.88]) was significantly lower than both the realistic threat group ($M = 4.55$, $SD = 0.96$, 95% CI [4.38, 4.73]) and identity threat group ($M = 4.85$, $SD = 0.95$, 95% CI [4.68, 5.03]), $p_s < 0.001$, while the realistic and identity threat groups did not differ significantly, $p = 0.057$. Using group as the independent variable and perceived robot identity threat as the dependent variable, one-way ANOVA showed a significant main effect, $F(2, 346) = 52.35$, $p < 0.001$, $\eta^2_p = 0.23$. Post-hoc Bonferroni comparisons indicated that the control group's identity threat rating ($M = 3.54$, $SD = 1.26$, 95% CI [3.31, 3.77]) was significantly lower than both the realistic threat group ($M = 4.47$, $SD = 1.10$, 95% CI [4.27, 4.68]) and identity threat group ($M = 5.07$, $SD = 1.10$, 95% CI [4.87, 5.27]), $p_s < 0.001$, and the identity threat group scored significantly higher than the realistic threat group, $p < 0.001$. These results indicate successful manipulation, with the identity threat manipulation producing stronger effects on perceived robot threat.

Using perceived robot threat (i.e., group; control = 1, realistic threat = 2, identity threat = 3) as the independent variable and workplace objectification as the dependent variable, one-way ANOVA revealed a significant main effect, $F(2, 346) = 3.68$, $p = 0.026$, $\eta^2_p = 0.02$. Post-hoc Bonferroni comparisons showed that the identity threat group's workplace objectification score ($M = 3.11$, $SD = 0.82$, 95% CI [2.96, 3.26]) was significantly higher than the control group ($M = 2.85$, $SD = 0.72$, 95% CI [2.72, 2.98]), $p = 0.028$, while the realistic threat group did not differ significantly from either the control or identity threat groups, $p_s > 0.05$.

To test whether sense of control mediates the effect of perceived robot threat on workplace objectification, we conducted a bias-corrected bootstrap test using SPSS PROCESS (Hayes et al., 2013), Model 4, with 5,000 resamples. In the 95% confidence interval, with perceived robot threat as the independent variable (control = 1, realistic threat = 2, identity threat = 3, specified as categorical), workplace objectification as the dependent variable, and sense of control as the mediator, mediation analysis showed that, using the control group as reference, the indirect effect through sense of control for the realistic threat group was 0.064, 95% CI [-0.025, 0.166], containing zero, indicating non-significant mediation. The indirect effect for the identity threat group was 0.116, 95% CI [0.027, 0.215], not containing zero, indicating significant mediation. After adding sense of control as a mediator, the direct effect of identity threat on workplace objectification was 0.132, 95% CI [-0.030, 0.330], containing zero, indicating the direct effect was no longer significant and sense of control exerted full mediation. These results demonstrate that perceived robot identity threat increases workplace objectification because it reduces people's sense of control, which in turn leads to greater objectification of others in the workplace.

4. Study 3: Compensatory Control Strategies as Moderators of the Relationship Between Perceived Robot Threat and Workplace Objectification

Study 3 includes three parallel sub-studies examining whether personal agency, external agency, and specific structure beliefs moderate the effect of perceived robot threat on workplace objectification. All three sub-studies use experimental manipulation. Study 3.1 manipulates both realistic and identity threat, but given the non-significant results for realistic threat in Study 2 and Study 3.1, Studies 3.2 and 3.3 focus only on identity threat versus control comparisons.

4.1.1 Participants

We used G*Power 3.1 to determine the required sample size. Based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor three-level between-subjects design required 321 participants to achieve 90% statistical power. Because the study investigated workplace objectification, we set the participation criterion as currently employed. Considering potential attention check failures, we recruited 340 participants through Credamo. After 10 participants failed attention checks, the final sample consisted of 330 participants (Mage = 31.56, SD = 7.25; 179 females, 54.2%).

4.1.2 Procedure

This study used a single-factor three-level between-subjects design. Participants were randomly assigned to realistic threat, identity threat, or control groups, with 110 participants in each condition. Manipulation procedures for the three groups were identical to Study 2.3. After the writing task, participants completed the perceived robot threat scale (same as Study 1.1; Cronbach' s $\alpha = 0.81$ for realistic threat, 0.90 for identity threat), sense of control questionnaire (same as Study 2.1; Cronbach' s $\alpha = 0.91$ for all items), personal agency scale, and workplace objectification scale (same as Study 1.1; Cronbach' s $\alpha = 0.81$).

The personal agency measure was partially adapted from previous compensatory control literature (Beck et al., 2020; Shepherd & Kay, 2018) and modified for this study' s purpose and context. This portion included three items: (1) "I believe I can decide how to control robots" ; (2) "I believe I have responsibility for controlling robots" ; (3) "I believe controlling robots is within my control." Additionally, based on compensatory control theory' s definition of personal agency as "the belief that one possesses the necessary resources to perform one or a set of behaviors required to produce specific results or achieve specific goals" (Landau et al., 2015), we added three items: (1) "I believe I can control robots" ; (2) "I believe I have the ability to control robots" ; (3) "I believe I have the resources to control robots." All personal agency items used a 7-point Likert format (1 = strongly disagree, 7 = strongly agree). Cronbach' s α was

0.91. Attention check items (e.g., “For this question, please select ‘strongly disagree’ ”) were embedded throughout, followed by demographic questions.

4.1.3 Results

Using group (control = 1, realistic threat = 2, identity threat = 3) as the independent variable and perceived robot realistic threat as the dependent variable, one-way ANOVA revealed a significant main effect, $F(2, 327) = 22.44, p < 0.001, \eta^2_p = 0.12$. Post-hoc Bonferroni comparisons showed that the control group’s realistic threat rating ($M = 3.93, SD = 1.04, 95\% CI [3.73, 4.12]$) was significantly lower than both the realistic threat group ($M = 4.71, SD = 1.04, 95\% CI [4.51, 4.90]$) and identity threat group ($M = 4.74, SD = 0.98, 95\% CI [4.55, 4.92]$), $p_s < 0.001$, while the realistic and identity threat groups did not differ significantly, $p = 1$. Using group as the independent variable and perceived robot identity threat as the dependent variable, one-way ANOVA showed a significant main effect, $F(2, 327) = 22.06, p < 0.001, \eta^2_p = 0.12$. Post-hoc Bonferroni comparisons indicated that the control group’s identity threat rating ($M = 3.83, SD = 1.43, 95\% CI [3.56, 4.10]$) was significantly lower than both the realistic threat group ($M = 4.55, SD = 1.28, 95\% CI [4.31, 4.79]$) and identity threat group ($M = 5.00, SD = 1.24, 95\% CI [4.76, 5.23]$), $p_s < 0.001$, and the identity threat group scored significantly higher than the realistic threat group, $p = 0.037$. These results indicate successful manipulation, with the identity threat manipulation producing stronger effects.

Using perceived robot threat (i.e., group; control = 1, realistic threat = 2, identity threat = 3) as the independent variable and workplace objectification as the dependent variable, one-way ANOVA revealed a significant main effect, $F(2, 327) = 4.76, p = 0.009, \eta^2_p = 0.03$. Post-hoc Bonferroni comparisons showed that the identity threat group’s workplace objectification score ($M = 3.23, SD = 0.93, 95\% CI [3.06, 3.41]$) was significantly higher than the control group ($M = 2.88, SD = 0.71, 95\% CI [2.74, 3.02]$), $p = 0.007$, while the realistic threat group did not differ significantly from either the control or identity threat groups, $p_s > 0.050$.

To test whether sense of control mediates the effect of perceived robot threat on workplace objectification, we conducted a bias-corrected bootstrap test using SPSS PROCESS (Hayes et al., 2013), Model 4, with 5,000 resamples. In the 95% confidence interval, with perceived robot threat as the independent variable (control = 1, realistic threat = 2, identity threat = 3, specified as categorical), workplace objectification as the dependent variable, and sense of control as the mediator, mediation analysis showed that, using the control group as reference, the indirect effect through sense of control for the realistic threat group was 0.107, 95% CI [-0.001, 0.244], containing zero, indicating non-significant mediation. The indirect effect for the identity threat group was 0.133, 95% CI [0.024, 0.268], not containing zero, indicating significant mediation. After adding sense of control as a mediator, the direct effect of identity threat on workplace objectification was 0.217, 95% CI [0.021, 0.412], not containing zero, indicating the

direct effect remained significant and sense of control exerted partial mediation. These results show that perceived robot identity threat increases workplace objectification because it reduces people' s sense of control, leading to greater objectification of others in the workplace.

To test whether personal agency moderates the effect of perceived robot threat on workplace objectification, we conducted a bias-corrected bootstrap test using SPSS PROCESS (Hayes et al., 2013), Model 1, with 5,000 resamples. In the 95% confidence interval, with perceived robot threat as the independent variable (control = 1, realistic threat = 2, identity threat = 3, specified as categorical), workplace objectification as the dependent variable, and personal agency as the moderator, moderation analysis showed that, using the control group as reference, the interaction between realistic threat and personal agency was not significant ($b = -0.14$, $SE = 0.11$, $t = -1.30$, $p = 0.193$), while the interaction between identity threat and personal agency was significant ($b = -0.32$, $SE = 0.11$, $t = -2.79$, $p = 0.005$). The realistic threat group did not differ significantly from the control group in workplace objectification ($b = 0.84$, $SE = 0.58$, $t = 1.45$, $p = 0.148$), while the identity threat group showed significantly higher workplace objectification than the control group ($b = 1.81$, $SE = 0.59$, $t = 3.09$, $p = 0.002$). Personal agency level did not significantly affect workplace objectification ($b = -0.07$, $SE = 0.09$, $t = -0.75$, $p = 0.452$). The model' s $\Delta R^2 = 0.02$, $F(2, 324) = 4.02$, $p = 0.019$. Under low personal agency, realistic threat did not significantly affect workplace objectification ($b = 0.28$, $SE = 0.17$, $t = 1.58$, $p = 0.116$), while identity threat significantly affected workplace objectification ($b = 0.57$, $SE = 0.17$, $t = 3.30$, $p = 0.001$). Under high personal agency, neither realistic threat ($b = -0.03$, $SE = 0.15$, $t = -0.19$, $p = 0.848$) nor identity threat ($b = -0.10$, $SE = 0.16$, $t = -0.62$, $p = 0.536$) significantly affected workplace objectification. These results indicate a significant interaction between identity threat and personal agency: when personal agency is low, identity threat significantly increases workplace objectification; when personal agency is high, identity threat does not significantly affect workplace objectification. Given the non-significant effects of realistic threat in Study 2 and Study 3.1, subsequent studies focused on identity threat, comparing identity threat and control groups.

4.2.1 Participants

We used G*Power 3.1 software (Faul et al., 2007) to determine the required sample size. For this study' s one-way ANOVA, based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor two-level between-subjects design required 200 participants to achieve 80% statistical power ($1-\beta$). Considering potential dropouts and attention check failures, we recruited 256 undergraduate students from a university who received course credit for participation. Participants completed online questionnaires through the Qualtrics platform after reading instructions and providing informed consent. Ultimately, 42 participants failed

to complete the study or failed attention checks, yielding 214 valid responses (121 females, 56.5%; Mage = 20.17, SD = 1.37).

4.2.2 Procedure

This study used a single-factor two-level between-subjects design. Participants were randomly assigned to identity threat or control groups, with 107 participants in each condition. Manipulation procedures for both groups were identical to Study 2.3. After the writing task, participants completed the perceived robot threat scale (same as Study 1.1; Cronbach's $\alpha = 0.61$ for realistic threat, 0.80 for identity threat), sense of control questionnaire (same as Study 2.1; Cronbach's $\alpha = 0.76$ for all items), external agency scale, and workplace objectification scale (same as Study 1.1; Cronbach's $\alpha = 0.66$).

The external agency measure was partially adapted from previous compensatory control literature (Beck et al., 2020; Shepherd & Kay, 2018) and modified for this study's purpose and context. This portion included five items: (1) "I want to delegate control of robots to the government" ; (2) "I want the government to control robots on my behalf" ; (3) "My control over robots seems to be determined by the government" ; (4) "My control over robots is the government's responsibility" ; (5) "My control over robots is in the government's hands." Additionally, based on compensatory control theory's description of external agency—where individuals relinquish autonomous control over their lives, delegating personal agency to external systems like God or government, depending on these systems to restore sense of control by believing they will mobilize resources to achieve outcomes consistent with their interests (Landau et al., 2015)—we added three items: (1) "I believe the government can control robots" ; (2) "I believe the government has the ability to control robots" ; (3) "I believe the government has the resources to control robots." All external agency items used a 7-point Likert format (1 = strongly disagree, 7 = strongly agree). Cronbach's α was 0.82. Attention check items (e.g., "For this question, please select 'strongly disagree' ") were embedded throughout, followed by demographic questions.

4.2.2 Results

One-way ANOVA showed that the identity threat group reported significantly higher realistic threat scores ($M = 4.19$, $SD = 0.78$, 95% CI [4.04, 4.33]) than the control group ($M = 3.88$, $SD = 0.71$, 95% CI [3.74, 4.01]), $F(1, 212) = 9.22$, $p = 0.003$, $\eta^2_p = 0.04$. The identity threat group also reported significantly higher identity threat scores ($M = 4.20$, $SD = 1.18$, 95% CI [3.97, 4.42]) than the control group ($M = 3.69$, $SD = 0.95$, 95% CI [3.51, 3.87]), $F(1, 212) = 11.91$, $p = 0.001$, $\eta^2_p = 0.05$. Manipulation was successful.

One-way ANOVA revealed that workplace objectification was significantly higher in the identity threat group ($M = 3.18$, $SD = 0.59$, 95% CI [3.07, 3.30]) than in the control group ($M = 3.00$, $SD = 0.63$, 95% CI [2.88, 3.12]), $F(1, 212) = 4.66$, $p = 0.032$, $\eta^2_p = 0.02$.

To test whether sense of control mediates the effect of perceived robot identity threat on workplace objectification, we used Hayes' s (2013) SPSS PROCESS macro (Model 4), with perceived robot identity threat as the independent variable (control = -1, identity threat = 1), sense of control as the mediator, and workplace objectification as the dependent variable, setting bootstrap samples to 5,000 with bias-corrected 95% confidence intervals. Results showed a significant indirect effect of sense of control (effect = 0.02, 95% CI [0.003, 0.051]). After controlling for the mediator, the direct effect of perceived robot identity threat on workplace objectification was 0.07, 95% CI [-0.012, 0.151], containing zero, indicating the direct effect was no longer significant and sense of control exerted full mediation.

Examining the interaction between perceived robot identity threat (control = -1, threat group = 1) and external agency on workplace objectification revealed a significant interaction ($b = -0.10$, $SE = 0.05$, $t = -1.98$, $p = 0.049$). The robot threat group showed significantly higher workplace objectification than the control group ($b = 0.09$, $SE = 0.04$, $t = 2.17$, $p = 0.031$). External agency level did not significantly affect workplace objectification ($b = 0.02$, $SE = 0.05$, $t = 0.44$, $p = 0.661$). The model' s $\Delta R^2 = 0.02$, $F(1, 210) = 3.92$, $p = 0.049$. As shown in [Figure 3: see original paper], simple slope analysis indicated that under low external agency, perceived robot identity threat significantly affected workplace objectification ($b = 0.18$, $SE = 0.06$, $t = 2.63$, $p = 0.004$), while under high external agency, the effect was not significant ($b = 0.01$, $SE = 0.06$, $t = 1.10$, $p = 0.920$).

[Figure 3: see original paper] Moderating effect of external agency

4.3.1 Participants

We used G*Power 3.1 to determine the required sample size. Based on previous robot workforce research (Jackson et al., 2020), assuming a medium effect size $f^2 = 0.2$, significance level $\alpha = 0.05$, a single-factor two-level between-subjects design required 200 participants to achieve 80% statistical power. Because the study investigated workplace objectification, we set the participation criterion as currently employed. Considering potential attention check failures, we recruited 208 participants through Credamo. After 8 participants failed attention checks, the final sample consisted of 200 participants (Mage = 31.78, SD = 7.31; 108 females, 54.0%).

4.3.2 Procedure

This study used a single-factor two-level between-subjects design. Participants were randomly assigned to identity threat or control groups, with 100 participants in each condition. Manipulation procedures were identical to Study 2.3. After the writing task, participants completed the perceived robot threat scale (same as Study 1.1; Cronbach' s $\alpha = 0.81$ for realistic threat, 0.89 for identity threat), sense of control questionnaire (same as Study 2.1; Cronbach' s $\alpha = 0.84$

for all items), specific structure beliefs scale, and workplace objectification scale (same as Study 1.1; Cronbach's $\alpha = 0.64$).

Based on compensatory control theory's description of affirming specific structure—believing that specific behaviors can reliably produce expected outcomes, with this clear “behavior—outcome” path being specific to the context where sense of control is reduced—and combining this with our research purpose and context, we developed specific structure belief items: (1) “I believe unplugging the power can control robots” ; (2) “I believe writing code can control robots” ; (3) “I believe destroying the robot's system can control robots” ; (4) “I believe there are specific behaviors that can control robots.” All items used a 7-point Likert format (1 = strongly disagree, 7 = strongly agree). Cronbach's α was 0.62. Attention check items (e.g., “For this question, please select ‘strongly disagree’ ”) were embedded throughout, followed by demographic questions.

4.3.2 Results

One-way ANOVA showed that the identity threat group reported significantly higher realistic threat scores ($M = 4.89$, $SD = 0.86$, 95% CI [4.72, 5.06]) than the control group ($M = 3.87$, $SD = 0.93$, 95% CI [3.69, 4.06]), $F(1, 198) = 63.85$, $p < 0.001$, $\eta^2 p = 0.24$. The identity threat group also reported significantly higher identity threat scores ($M = 5.07$, $SD = 1.06$, 95% CI [4.86, 5.28]) than the control group ($M = 3.80$, $SD = 1.21$, 95% CI [3.56, 4.04]), $F(1, 198) = 61.84$, $p < 0.001$, $\eta^2 p = 0.24$. Manipulation was successful.

One-way ANOVA revealed that workplace objectification was significantly higher in the identity threat group ($M = 3.32$, $SD = 0.65$, 95% CI [3.19, 3.44]) than in the control group ($M = 3.10$, $SD = 0.66$, 95% CI [2.97, 3.23]), $F(1, 198) = 5.59$, $p = 0.019$, $\eta^2 p = 0.03$.

To replicate the test of sense of control's mediating role, we used Hayes's (2013) SPSS PROCESS macro (Model 4), with perceived robot identity threat as the independent variable (control = -1, identity threat = 1), sense of control as the mediator, and workplace objectification as the dependent variable, setting bootstrap samples to 5,000 with bias-corrected 95% confidence intervals. Results showed a significant indirect effect of sense of control (effect = 0.03, 95% CI [0.003, 0.067]). After controlling for the mediator, the direct effect of perceived robot identity threat on workplace objectification was 0.08, 95% CI [-0.005, 0.169], containing zero, indicating the direct effect was no longer significant and sense of control exerted full mediation.

Examining the interaction between perceived robot identity threat (control = -1, threat group = 1) and specific structure beliefs on workplace objectification revealed a significant interaction ($b = -0.14$, $SE = 0.05$, $t = -2.76$, $p = 0.006$). The robot threat group showed significantly higher workplace objectification than the control group ($b = 0.11$, $SE = 0.05$, $t = 2.38$, $p = 0.018$). Specific structure belief level did not significantly affect workplace objectification ($b = 0.01$, $SE = 0.05$, $t = 0.25$, $p = 0.806$). The model's $\Delta R^2 = 0.04$, $F(1,$

196) = 7.63, $p = 0.006$. As shown in [Figure 4: see original paper], simple slope analysis indicated that under low specific structure beliefs, perceived robot identity threat significantly affected workplace objectification ($b = 0.24$, $SE = 0.07$, $t = 3.64$, $p < 0.001$), while under high specific structure beliefs, the effect was not significant ($b = -0.02$, $SE = 0.07$, $t = -0.27$, $p = 0.784$).

[Figure 4: see original paper] Moderating effect of specific structure beliefs

5. Discussion

Across three studies (eight sub-studies), results demonstrated that perceived robot threat increases workplace objectification, with sense of control mediating this relationship, and three alternative compensatory control strategies—strengthening personal agency, supporting external agency, and affirming specific structure—moderating the effect of perceived robot threat on workplace objectification. Specifically, a large-scale questionnaire survey of robot company employees first revealed the positive correlation between perceived robot threat and workplace objectification (Study 1.1). Multiple research methods then repeatedly verified that perceived robot threat increases workplace objectification (Studies 1.2–3.3). Through measuring participants' sense of control, we further identified control compensation as the mediating mechanism—perceiving robot threat reduces sense of control, which in turn leads to compensatory workplace objectification (Studies 2.1–2.3). Moreover, we found that perceived robot identity threat primarily drives differences in workplace objectification (Study 2.3). By measuring the three alternative compensatory control strategies, we also found moderating effects of personal agency (Study 3.1), external agency (Study 3.2), and specific structure beliefs (Study 3.3) on the relationship between perceived robot threat and workplace objectification.

More interestingly, when decomposing perceived robot threat, this study actually found that perceived robot identity threat has a stronger effect on workplace objectification than perceived robot realistic threat, and sense of control mediates the path from identity threat to workplace objectification. That identity threat more strongly increases workplace objectification partially addresses discrepancies in previous robot threat research. For example, Huang et al. (2021) found that identity threat better predicts negative attitudes toward robots compared to realistic threat. This conclusion is not absolute, however, as Złotowski et al. (2016) found both robot realistic and identity threats mediate negative attitudes toward robots and increased opposition to robotics research, with realistic threat showing stronger mediation. Our study found effects for both realistic and identity threats on workplace objectification, but identity threat showed stronger effects, and sense of control only mediated identity threat. Similarly, the three alternative compensatory control strategies only moderated identity threat's effect on workplace objectification. These findings indicate that robot identity threat constitutes the primary factor increasing workplace objectification and the main mechanism triggering control compensation. This may relate

to our dependent variable—workplace objectification. Since “workplace” itself is closely associated with realistic threats to jobs, identity threat may already encompass realistic threat to some extent and exceed it in magnitude.

In workplace objectification contexts, robot identity threat increases objectification not only by displacing human jobs but also by blurring the boundary between humans and machines, thereby threatening human uniqueness (Yogeeswaran et al., 2016). In the same context, human uniqueness can be either threatened or highlighted, representing two sides of the same coin that produce different outcomes depending on perspective. Some research has found that robots may enhance people’s panhumanism, leading them to view fellow humans more as ingroup members, thereby reducing prejudice and producing positive interpersonal effects (Jackson et al., 2020). Our study, approaching from the perspective of perceived robot threat, found that it increases workplace objectification, thus verifying robots’ potential negative interpersonal consequences—clearly opposite to Jackson et al.’s (2020) findings of positive effects. We also measured panhumanism but did not find positive effects similar to previous research (Jackson et al., 2020). This discrepancy may stem from the competitive nature of workplaces, making the “threat” perspective more salient than the “highlighting” perspective. Although our experimental manipulation materials were essentially the same (Chinese translation version) as Jackson et al.’s (2020), their study only manipulated robot “salience” without involving robot “threat,” whereas our participants completed the perceived robot threat scale as a manipulation check after reading materials, which may have reminded and emphasized robot threat. Our results actually align with previous research on robots’ impact on human relationships, such as findings that robot occupation of limited human resources makes human relationships more tense rather than positive (e.g., Frey et al., 2018; Im et al., 2019). Additionally, in relative terms, objectifying others simultaneously creates distance from them, generating a sense of superiority and “contrast” effects. While this paper focused on objectifying others, future research could more deeply examine the issue of relative advantage that people experience when threatened by robots.

The consequences of robot identity threat also have practical implications. While robot infiltration into workplaces may inevitably create realistic threats to jobs and resources, identity threats to human uniqueness can be reduced to some extent. For example, many robots are currently designed with anthropomorphic features, and research has found positive effects of robot anthropomorphism, such as increased trust (Rehm & Krogsgager, 2013) and more praise with less punishment (Bartneck et al., 2007). However, higher degrees of robot anthropomorphism also increase perceived threat, especially when robots’ abilities exceed humans’ (Yogeeswaran et al., 2016). Our findings further explore the negative interpersonal consequences—workplace objectification—of perceived robot threat, particularly identity threat. Since making robots too human-like poses identity threats that produce negative effects, robot design must carefully balance anthropomorphism to prevent such negative outcomes.

Despite this series of studies exploring the phenomenon, psychological mechanisms, and boundary conditions of perceived robot threat's effect on workplace objectification, several limitations remain for future improvement. First, the direction of workplace objectification needs expansion. This paper primarily examined lateral workplace objectification (i.e., between colleagues), but objectification can also be downward (e.g., leaders toward employees; Gruenfeld et al., 2008; Landau et al., 2012) or upward (e.g., employees toward leaders; Inesi et al., 2014). Different objectification directions may produce different sense of control effects, thereby influencing workplace objectification outcomes. Second, ecological validity could be improved. Although our eight sub-studies diversified participant sources, including undergraduate students, online participants from across the country, and actual frontline workers in robot factories, future research could include workers from more industries who may encounter robots, replicating our findings. Additionally, this research primarily used questionnaires and online experiments, measuring workplace objectification through self-report without observing actual behavior. Future research could use field experiments where participants interact with real robots to experience threat, observing actual behavior in more realistic social contexts. Regarding experimental design details, the writing task instructions for control groups in studies like 2.3 had relatively positive emotional valence, which may have influenced results. Future research should use more neutral instructions.

6. Conclusion

This study concludes: First, perceived robot threat increases workplace objectification, with perceived robot identity threat having a stronger effect. Second, sense of control mediates the effect of perceived robot threat (primarily identity threat) on workplace objectification. Third, three alternative compensatory control strategies—strengthening personal agency, supporting external agency, and affirming specific structure—moderate the effect of perceived robot threat on workplace objectification.

References

- Adler, N. E., Epel, E. S., Castellazzo, G., & Ickovics, J. R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. *Health Psychology, 19*(6), 586-592.
- Alexander, F., Schmidt, Lisa, M., & Kistemaker. (2015). The sexualized-body-inversion hypothesis revisited: Valid indicator of sexual objectification or methodological artifact?. *Cognition, 134*, Baldissarri, C., Valtorta, R. R., Andrighetto, L., & Volpato, C. (2017). Workers as objects: The nature of working objectification and the role of perceived alienation. *TPM - Testing, Psychometrics, Methodology in Applied Psychology, 24*, 153-166.
- Bartneck, C., Reichenbach, J., & Carpenter, J. (2007). Use of praise and punish-

ment in human-robot collaborative teams. *ROMAN 2006 - The 15th IEEE International Symposium on Robot and Human Interactive Communication* (pp.177-182). Hatfield, UK.

Beck, J. T., Rahinel, R., & Bleier, A. (2020). Company worth keeping: Personal control and preferences for brand leaders. *Journal of Consumer Research*, *46*(5), 871-886.

Belmi, P., & Schroeder, J. (2021). Human “resources”? Objectification at work. *Journal of Personality and Social Psychology*, *120*(2), 384-417.

Borenstein, J. (2011). Robots and the changing workforce. *AI & Society*, *26*(1), 87-93.

Calogero, R. M. (2013). Objects don't object: Evidence that self-objectification disrupts women's social activism. *Psychological Science*, *24*, 312-318.

Calogero, R. M. (2013). Objects don't object: Evidence that self-objectification disrupts women's social activism. *Psychological Science*, *24*(3), 312-318.

Frey, C. B., Berger, T., & Chen, C. (2018). Political machinery: Did robots swing the 2016 U.S. presidential election? *Oxford Review of Economic Policy*, *34*, 418-442.

Gervais, S. J., DiLillo, D., & McChargue, D. (2014). Understanding the link between men's alcohol use and sexual violence perpetration: The mediating role of sexual objectification. *Psychology of Violence*, *4*, 156-169.

Greenaway, K. H., Louis, W. R., Hornsey, M. J., & Jones, J. M. (2014). Perceived control qualifies the effects of threat on prejudice. *British Journal of Social Psychology*, *53*(3), 422-442.

Gruenfeld, D. H., Inesi, M. E., Magee, J. C., & Galinsky, A. D. (2008). Power and the objectification of social targets. *Journal of Personality and Social Psychology*, *95*(1), 111-127.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.

Huang, H. L., Cheng, L. K., Sun, P. C., & Chou, S. J. (2021). The effects of perceived identity threat and realistic threat on the negative attitudes and usage intentions toward hotel service robots: The moderating effect of the robot's anthropomorphism. *International Journal of Social Robotics*, *13*, 1599-1611.

Im, Z. J., Mayer, N., Palier, B., & Rovny, J. (2019). The “losers of automation”: A reservoir of votes for the radical right? *Research & Politics*, *6*, 1-7.

Inesi, M. E., Lee, S. Y., & Rios, K. (2014). Objects of desire: Subordinate ingratiation triggers self-objectification among powerful. *Journal of Experimental Social Psychology*, *53*, 19-30.

Jackson, J. C., Castelo, N., & Gray, K. (2020). Could a rising robot workforce make humans less prejudiced?. *American Psychologist*. Advance online

publication.

Kant, I. (1996). *The metaphysics of morals* (M. Gregor, Trans.). Cambridge, UK: Cambridge University Press. (Original work published 1797)

Kay, A. C., Gaucher, D., Napier, J. L., Callan, M. J., & Laurin, K. (2008). God and the government: Testing a compensatory control mechanism for the support of external systems. *Journal of Personality and Social Psychology, 95*, 18–35.

Kay, A. C., Whitson, J. A., Gaucher, D., & Galinsky, A. D. (2009). Compensatory control: Achieving order through the mind, our institutions, and the heavens. *Current Directions in Psychological Science, 18*, 264–268.

Lachman, M. E., & Weaver, S. L. (1998). The sense of control as a moderator of social class differences in health and well-being. *Journal of Personality and Social Psychology, 74*(3), Landau, M. J., Kay, A. C., & Whitson, J. A. (2015). Compensatory control and the appeal of a structured world. *Psychological Bulletin, 141*(3), 694–722.

Landau, M. J., Sullivan, D., Keefer, L. A., Rothschild, Z. K., & Osman, M. R. (2012). Subjectivity uncertainty theory of objectification: Compensating for uncertainty about how to positively relate to others by downplaying their subjective attributes. *Journal of Experimental Social Psychology, 48*(6), 1234–1246.

Leo, X., & Huh, Y. E. (2020). Who gets the blame for service failures? Attribution of responsibility toward robot versus human service providers and service firms. *Computers in Human Behavior, 113*(4), 106520.

Marx, K. (1964). *Early writings* (T. B. Bottomore, Trans.). New York, NY: McGraw-Hill. (Original work published 1844)

McClure, P. K. (2018). “You’ re fired,” says the robot: The rise of automation in the workplace, technophobes, and fears of unemployment. *Social Science Computer Review, 36*(2), 139–156.

McFarland, S., Webb, M., & Brown, D. (2012). All humanity is my ingroup: A measure and studies of identification with all humanity. *Journal of Personality and Social Psychology, 103*, 830–

Murashov, V., Hearl, F., & Howard, J. (2016). Working safely with robot workers: Recommendations for the new workplace. *Journal of Occupational and Environmental Hygiene, 13*(3), D61–D71.

Nussbaum, M. C. (1995). Objectification. *Philosophy & Public Affairs, 24*, 249–291.

Nussbaum, M. C. (1999). *Sex and social justice*. New York, NY: Oxford University Press.

Orehek, E., & Weaverling, C. G. (2017). On the nature of objectification: Implications of considering people as means to goals. *Perspectives on Psychological Science, 12*, 719-730.

Pew Research Center. (2017). *Automation in everyday life*, 4 October.

Rehm, M., & Krogsager, A. (2013). Negative affect in human robot interaction-impoliteness in unexpected encounters with robots. *RO-MAN, 2013 IEEE*, 45-50.

Saguy, T., Quinn, D. M., Dovidio, J. F., & Pratto, F. (2010). Interacting like a body: Objectification can lead women to narrow their presence in social interactions. *Psychological Science, 21*(2), Shepherd, S., & Kay, A. C. (2018). Guns as a source of order and chaos: Compensatory control and the psychological (dis)utility of guns for liberals and conservatives. *Journal of the Association for Consumer Research, 3*(1), 16-26.

Skowronski, M., Busching, R., & Krahe, B. (2021). The effects of sexualized video game characters and character personalization on women's self-objectification and body satisfaction. *Journal of Experimental Social Psychology, 92*(1), 104051.

Stephan, W. G., Ybarra, O., & Rios, K. (2015). Intergroup threat theory. In T. D. Nelson (Ed.), *Handbook of prejudice, stereotyping, and discrimination* (2nd ed., pp. 255-278). Mahwah, NJ: Lawrence Erlbaum Associates.

Taskin, L., Parmentier, M., & Stinglhamber, F. (2019). The dark side of office designs: Towards dehumanization. *New Technology, Work and Employment, 34*(3), 262-284.

Thompson, S. C., & Schlehofer, M. M. (2008). Control, denial, and heightened sensitivity reactions to personal threat: Testing the generalizability of the threat orientation approach. *Personality and Social Psychology Bulletin, 34*(8), 1070-1083.

Xu, L., Yu, F., Peng, K., & Wang, X. (2022). Algorithmic discrimination causes less desire for moral punishment than human discrimination. *Advances in Psychological Science, 30*(9), 1905-

[许丽颖, 喻丰, 彭凯平, 王学辉. (2022). 智慧时代的螺丝钉: 机器人凸显对职场物化的影响. *心理科学进展, 30*(9), 1905-1921.]

Xu, L., Yu, F., Wu, J., Han, T., & Zhao, L. (2017). Anthropomorphism: Antecedents and consequences. *Advances in Psychological Science, 25*(11), 1942-1954.

[许丽颖, 喻丰, 邬家骅, 韩婷婷, 赵靓. (2017). 拟人化: 从“它”到“他”. *心理科学进展, 25*(11), 1942-1954.]

Yang, S., Guo, Y., Hu, X., Shu, S., & Li, J. (2016). Do lower class individuals possess higher levels of system justification? An examination from the social cognitive perspectives. *Acta Psychologica Sinica, 48*(11), 1467-1478.

[杨沈龙, 郭永玉, 胡小勇, 舒首立, 李静. (2016). 低阶层者的系统合理化水平更高吗?——基于社会认知视角的考察. *心理学报*, 48(11), 1467-1478.]

Yogeeswaran, K., Zlotowski, J., Livingstone, M., Bartneck, C., Sumioka, H., & Ishiguro, H. (2016). The interactive effects of robot anthropomorphism and robot ability on perceived threat and support for robotics research. *Journal of Human-Robot Interaction*, 5(2), 29-47.

Yu, F. (2020). On AI and human beings. *Frontiers*, (1), 30-36.

[喻丰. (2020). 人工智能与人之为. *人民论坛·学术前沿*, (1), 30-36.]

Yu, F., & Xu, L. (2018). How to make an ethical artificial intelligence? Answer from a psychological perspective. *Global Media Journal*, 5(4), 24-42.

[喻丰, 许丽颖. (2018). 如何做出道德的人工智能体? 心理学的视角. *全球传媒学刊*, 5(4), 24-42.]

Yu, F., & Xu, L. (2020). Artificial intelligence and anthropomorphism. *Journal of Northwest Normal University (Social Sciences)*, 57(5), 52-60.

[喻丰, 许丽颖. (2020). 人工智能之拟人化. *西北师大学报 (社会科学版)*, 57(5), 52-60.]

Zhang, Y., Xu, L., Yu, F., Ding, X., Wu, J., & Zhao, L. (2022). A three-dimensional motivation model of algorithm aversion. *Advances in Psychological Science*, 30(5), 1093-1105.

[张语嫣, 许丽颖, 喻丰, 丁晓军, 邬家骅, 赵靓. (2022). 算法拒绝的三维动机理论. *心理科学进展*, 30(5), 1093-1105.]

Zhou, H., & Long, L. (2004). Statistical remedies for common method biases. *Advances in Psychological Science*, 12(6), 942-950.

[周浩, 龙立荣. (2004). 共同方法偏差的统计检验与控制方法. *心理科学进展*, 12(6), 942-950.]

Zlotowski, J., Yogeeswaran, K., & Bartneck, C. (2017). Can we control it? Autonomous robots threaten human identity, uniqueness, safety, and resources. *International Journal of Human-Computer Studies*, 100, 48-54.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv – Machine translation. Verify with original.